Gas Journal

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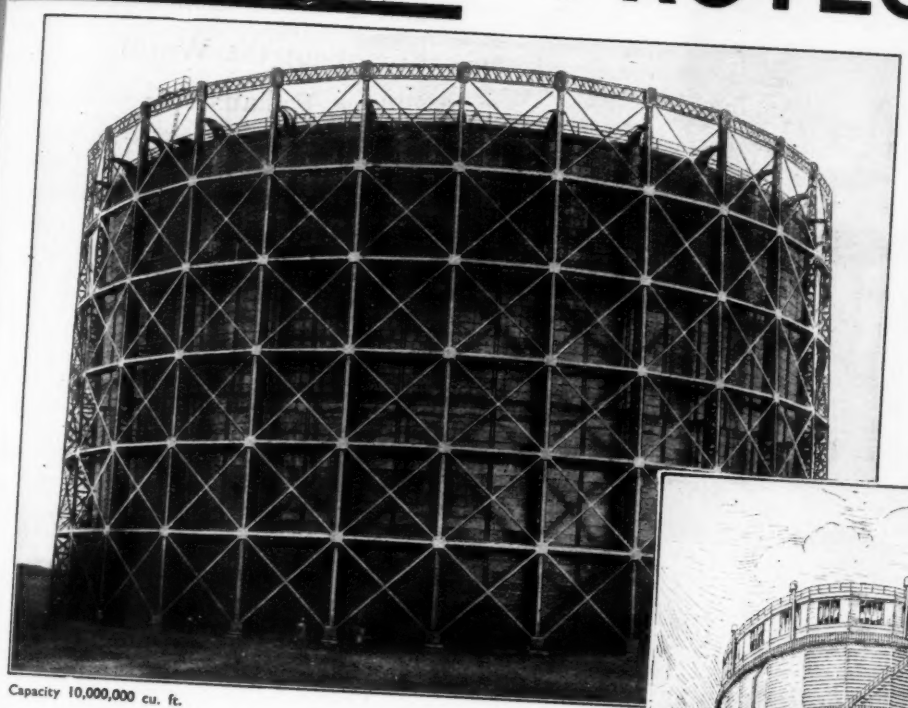

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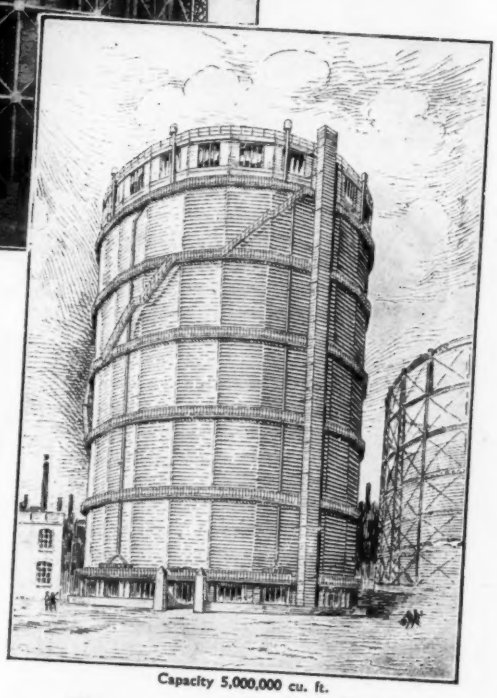

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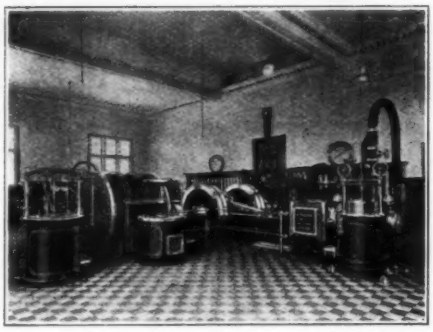

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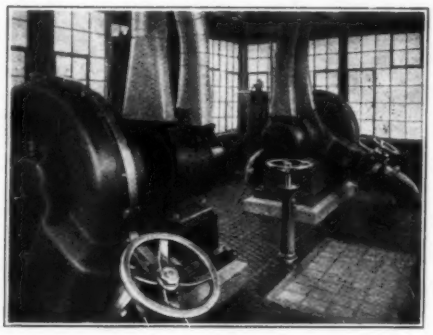

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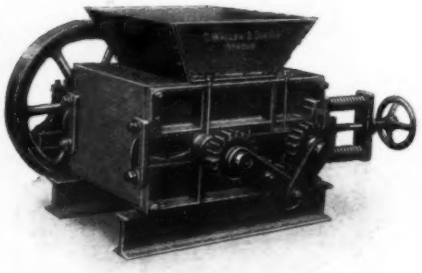

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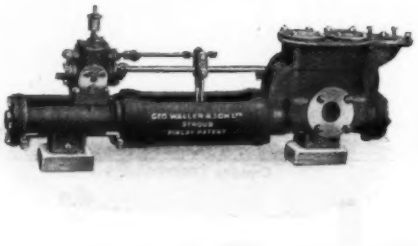

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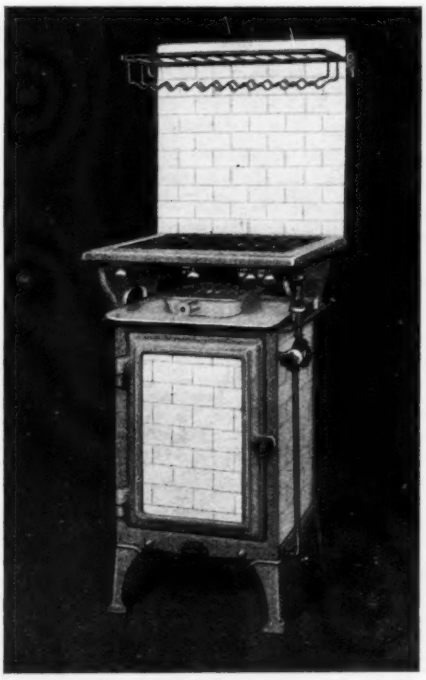

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Gas Journal

AUGUST 14, 1935

Vol. 211. 87th Year No. 3769

Editorial Notes

Flueless Appliances

"THE building in London and other large cities of workmen's dwellings in which the rooms, save the kitchen and perhaps one other, are provided with ventilating grids instead of chimney flues is an innovation which should be prohibited as false economy and inconsistent with any proper standard of health." With this statement of Professor W. A. Bone in an article in a recent issue of *The Nineteenth Century and After* we are in complete agreement. The fact remains, however, that such buildings are being erected, and it is a fact which concerns the Gas Industry very much indeed, for the electrical interests are putting forward the old, old story of gas appliances and "fumes," maintaining that on grounds of health and safety electricity is the one and only proper heating medium for rooms not provided with flues. The truth of the matter is that gas is every bit as safe and every bit as healthy as electricity for warming rooms in which there are no flues. Well-designed gas appliances will, when properly installed and regulated, operate with perfect safety and complete combustion. The fitting of a fluepipe is determined by quantity of products in relation to the size of room. Fluepipe is a precaution not against danger, but against discomfort; and as it is estimated that 80% of the gas used in this country is consumed in appliances without flues, there is nothing either new or alarming about the use of flueless appliances. Flueless heating appliances *must be a second best* to the ventilated gas fire because comfort depends upon warmth and fresh air. The gas fire with a flue provides both; the flueless heater—it makes no difference whether it is gas or electric—only provides the warmth.

As we have said, the erection of buildings not adequately provided with flues is a bad system which in time *must* be condemned. But the important point we would emphasize here is that dwellers in such buildings need suffer no deprivation of gas heating, which is so very much more economical than electric heating. Any doubts on this score will be dispelled once and for all by an interim report which appeared last week in the Medical Press and which is reprinted on later pages of our issue to-day. It is a document of the greatest importance to the Gas Industry and to the general public. It carries the stamp of the highest authority, the President of the Royal College of Physicians having approved the formation of a Medical Advisory Committee to examine available information on the matter, to initiate such research as may be thought necessary, and to make recommendations. The Committee has been constituted as follows: Dr. W. W. Jameson, Dean and Professor of Public Health, London School of Hygiene and Tropical Medicine; Sir Joseph Barcroft, Professor of Physiology, Cambridge University; Sir Arthur J. Hall, Emeritus Professor of Medicine, Sheffield University; Dr. Reginald Hilton, Assistant Physician, St. Thomas's Hospital; Dr. Guy Crowden, Lecturer in Industrial Physiology, London School of Hygiene and Tropical Medicine. This is surely a Committee of eminent men, and it is to be noted that two of them appeared in the Jubilee Honours List for work which has a particular bearing on this very subject.

The Safety Aspect

THE document on later pages, which we know will be carefully studied, clears up any doubts in the mind of the public concerning the hygienic effects of products of combustion, and it shows that, *with correct gas rate*, flueless gas heaters can be employed with absolute safety. The maximum gas rate suggested is 1 cu.ft. per 50 cu.ft. of room space, which will allow rapid heating up of the room and will fix a limit to the degree of overheating which is possible, thereby preventing undesirably high concentrations of products of combustion. This is for intermittent use. For average conditions an allowance of 1 cu.ft. of gas per 100 cu.ft. of room capacity would be sufficient to maintain comfort if the gas heater were in continuous operation. The Committee state that since the air change in flueless rooms may be as small as one per hour, it is open to serious doubt whether a degree of ventilation of this low order can be regarded as satisfactory whatever the nature of the heating, and whether this modern tendency in housing construction is, from the point of view of health and comfort, in the best interests of the community. "Any form of heating in small unventilated rooms which tends to lead to accumulations of hot stagnant air is objectionable. In this respect flueless gas heaters are no better and no worse than alternative appliances. Any risk to health from the inhalation of products of combustion from flueless gas heaters is discounted by the fact that, even with an air change as low as one per hour, discomfort from overheating would be experienced long before harmful concentrations of such products would be reached."

The flueless room is a bad thing for the public, and this doctrine should be preached on every possible occa-

sion until the building industry is forced to provide only dwellings with adequate ventilation. The public now, however, have the assurance that any discomfort they may experience is due to this basic fact and not to whether the heating appliance is gas or electricity. The Committee's report shows that the economy of gas can be enjoyed without qualm, and it gives the direct answer to any misguided and mischievous propaganda which the electricity industry may employ. At the same time the Gas Industry must increase rather than slacken its efforts to ensure that combustion is perfect in every appliance installed; *and no mean consideration in this regard is the still further reduction in the amount of sulphur compounds in the gas supplied.*

Oil from Coal

A QUESTION asked recently in the House of Commons concerning the progress at Billingham in the extraction of oil from coal evoked quite an interesting reply from the Secretary for Mines. Captain Crookshank, by way of answer, circulated a statement supplied by Imperial Chemical Industries, to the effect that 7,500,000 gallons of petrol had already been manufactured. Contracts had been arranged by I.C.I. for the purchase of creosote oil and low temperature tar oils as raw materials for hydrogenation at prices which should materially benefit the carbonizing industries. The total quantity of these materials contracted for was based on the programme of making 100,000 tons of petrol direct from coal and 50,000 tons from tar products, equal in all to 45,000,000 gallons a year. The coal required when the plant was in full operation would, including that required for the treatment of creosote and low-temperature tar, amount to well over 500,000 tons, representing the employment of about 1,950 miners.

For our part, we should have preferred the statement couched in somewhat different terms. Some little credit might well have been given to the carbonizing industries, we suggest, for having readily available the raw material which gave the hydrogenation scheme a flying start and which is destined to play such an important part in the future operations of the Billingham plant. And it seems to us a little out of place for the hydrogenation scheme to be credited with giving employment to miners for the production of creosote, when those miners were in fact employed for the mining of coal for carbonization to produce smokeless fuels—gas and coke—and incidentally creosote. It is the same story to which we referred in these columns last week. We said that in practically every discussion, whether inside or outside the House, on the proper treatment of coal, there is a complete absence of any mention of the extremely valuable part which the Gas Industry plays in this respect. Is the work of our Industry in helping the Government-backed I.C.I. scheme going to pass unnoticed by both politicians and general public? And, if so, whose fault is it?

This Antiquated Gas

THE latest available official figures show a twelve-month increase in the amount of gas sold for public lamps of 112 million cu.ft. From time to time during recent months we have been able to record with satisfaction, though with the reverse of surprise, that borough after borough has entered into long-period contracts for improved gas lighting for its streets. Last month, for example, we were able to announce a ten-year contract for the entire street lighting in the Borough of Northampton by gas. In the Metropolis recently new contracts have been signed for gas lighting for periods up to as long as fifteen years. Last year the Gas Light and Coke Company were able to register an increase in the amount of gas used for street lighting of 2·4%, which, considering the vast quantity of gas they sell for this purpose, represents no mean volume of additional business. Where gas is given a fair trial and is able to demonstrate to unbiased judges what a *modern* gas installation can achieve, gas wins. The truth is that local authorities are not merely becoming weary of the frequent failures of electric lighting systems, but are becoming alarmed about them.

Hence we are amused by a letter from "Pro Bono Publico"—how tiresome this pen name is—published in a local paper immediately following a report of a meeting of the Cambridge Town Council when, as we reported last week, it was decided after considerable debate to enter into a ten-year contract with the Cambridge University and Town Gas Light Company for street lighting. P.B. Publico says that it is not a pleasant thought that long before ten years' time the public lighting of Cambridge will be conspicuous as a museum exhibit of how streets used to be lighted. He need not suffer loss of sleep about that; gas lighting is improving every day. Our Industry is awakening to the need for greater study of public lighting technique, in the knowledge of the possibilities which lie ahead. Cambridge affords a good example of a fair field in that both gas and electricity supplies are privately owned. During the Council debate on the Street Lighting Committee's recommendation to accept the tender of the Gas Company, the reliability of gas was, quite rightly, emphasized by Alderman Raynes, who called attention, in passing, to the failure of the electric light in the House of Commons a week or two ago. While the House was in darkness, the streets of Westminster, thanks to gas, were undisturbed. Councillor Ambrose, however—and he was roundly supported by Councillor Stubbs—spoke of gas as an antiquated lighting system.

Other speakers against the ten-year gas contract referred to the electric gaseous discharge lamp, which reminds us of the remarks of Mr. S. B. Langlands, Inspector of Lighting to the Corporation of Glasgow, at a joint session recently of the Illuminating Engineering Society and the Association of Public Lighting Engineers held in connection with the National Safety Congress in London. He is reported to have said: If the electric discharge lamps were displeasing to the average citizens, why thrust upon them something they did not want? He had had scouts on the streets in Glasgow to ascertain what the public thought of the electric discharge lamps, and the results had been wonderful. Some of the language reported was shocking, but, as a result, the Department and the Corporation knew exactly how they stood!

What impresses us very much indeed about the Cambridge debate is the nature of the voting for and against the Street Lighting Committee's recommendation. The actual voting was 22 for and 19 against gas—on the face of it a small majority. But all the seven women councillors voted solid for electricity, and none of them refrained from voting, as did twelve men. There is surely something in this for the Gas Industry to note and get busy about. It certainly points to the necessity for strong and active Women's Gas Associations. The Street Lighting Committee had gone thoroughly, from the economic and technical points of view, into the relative merits of lighting the town by gas and electricity, and had arrived at a definite conclusion on a complicated question. Whereupon all the women councillors vote against their own Committee. A little more counter-instruction, please!

Reducing Accident Risk

So far as statistics may be fairly comparable, accident risks in factory industries as a whole appear to show an encouraging tendency to become fewer in proportion to the total number of employees; but there is still room for further reduction in such risks. What steps remain to be taken? Employers of labour, and those of us whose business leads us into places in which productive or manufacturing operations are carried on, are well aware of the good work accomplished by " Safety First " campaigns, and of the appeals so tellingly made by means of pictures and the printed word.

That these means do not, however, exhaust the possibilities is shown, in his last annual report, by the Chief Inspector of Factories and Workshops, who is concerned at the high accident incidence among young workers. This is a matter which may have no very close connection with actual gas manufacturing operations, but other branches of the Industry, at any rate, will be glad to have attention drawn to remedial suggestions. In divers directions, and in various enactments, a good deal has already been accomplished, but the Chief Inspector expresses doubts as to whether statutory action is the most effective method of tackling the problem. Statistics point to the fact that the excess of accidents among young workers is general through the whole of industry, and he feels that " the true solution lies, as in so many other instances, in the goodwill and voluntary efforts of employers and others, rather than in legislation which would be very difficult both to draft and to enforce."

One suggested step is education during school-life, through extending the lessons now directed against road-traffic dangers to include industrial risks—a practice which it is understood already prevails in Germany. Another proposal—and this comes more into the domain of the employer—is that, before starting work, every new entrant into industry might be taken round the factory and shown the principal risks. Some firms already do this, and a demonstration of the kind, in the opinion of the Chief Inspector, is likely to have even more effect than the usual practice of supplying each entrant with a copy of safety rules. An obvious precaution is to select the task for the beginner, so as to avoid undue risks.

With regard to employees as a whole, experience has shown that a common cause of accidents is lack of knowledge of the circumstances in which such troubles may arise, and of the risks inherent in many processes and methods of working. Here, of course, " Safety First " pictures, showing the dire effects that may follow upon carelessness or inefficiency, are of great value, but the Chief Inspector has yet another suggestion to put forward. It will be admitted that few persons can be so well versed in accident risks as the Inspectors of Factories, who in the ordinary course of their duties are called upon to make careful enquiry into all serious accidents, and as far as possible to propose preventive measures; and it seemed reasonable to assume that if the results of their accumulated experience could be broadcast on a really wide basis, so as to be accessible to management and workers alike, the educative effect would be of immense value. Hence, two years ago it was decided to issue from His Majesty's Stationery Office, under the title of " Industrial Accidents " (price 1s. 4d. a year, post free), accounts of such occurrences, and in this way descriptions of over 250 accidents have already appeared. A wider circulation of this quarterly publication should present an opportunity for eliminating many of the accidents due to the human element, through careful attention to the lessons to be learned from the past.

Good Lighting Pays

The reported result of an investigation carried out by the Illumination Committee of the Department of Scientific and Industrial Research in connection with the operation of tile pressing, selected as a representative example of " rough work," will afford valuable support to the Factory Inspectors in their efforts to secure, wherever needed, the better lighting conditions which are so vital from the points of view of health and safety. The test is stated to have proved conclusively that " where continuous work of this kind has to be carried out, the employment of low rates of illumination is likely to result in losses of output which are considerably greater than the cost of maintaining a standard of reasonably good illumination." Here, then, is a third reason for the adequate lighting which is still absent in many cases—judging by the remark of the Chief Inspector of Factories in his last report, that " although improvements, including numerous new installations, have been noted during the past year, advance in lighting efficiency generally has not kept step with progress in those factory conditions—*e.g.*, fencing and ventilation—in respect of which there are legal requirements."

It seems strange that, in certain trades, in particular, inefficient lighting remains prevalent. Trade revival in the iron founding industry, for instance, has brought improvement only in a minority of cases, and most foundries are said to be still poorly lit, though where improvement has occurred very high standards have been reached. The same complaint is made regarding many factories in the steel tool, cutlery, and silversmiths' trades; and in the potteries, also, the general standard of illumination is reported as remaining poor. In contrast with these unsatisfactory conditions, must be mentioned the various new and improved installations. Cases in which the lighting needs of each worker are individually considered (a valuable principle) have been noted. Progress has been made, too, in the lighting of several factories producing clothing. In some of these, general lighting, augmented by individual local points, has proved effective for machine work; while in one case " a purely general system, using high-pressure gas, has been satisfactorily adopted."

In spite, however, of these good examples, there is clearly an abundance of valuable work waiting to be done, to the benefit alike of the workers, the employers, and the light supplying industries. In addition to the higher standard of illumination too often needed, reference is made—particularly in connection with the clothing trades in London—to the fact that much remains to be done to secure for the workers some protection from the severe glare present in the majority of the factories and workshops.

A useful hint is to be found in mention of beneficial results following a change in the lighting scheme of a printing works. The lighting of the machines was good; but the general illumination was poor. As might have been expected, the workpeople, thus subjected to excessive contrasts, complained of constant headache, following eye strain. Expert advice was sought, and adequate general lighting subsequently installed. By this means the trouble was entirely obviated, and no further complaints have been received.

The necessity for instructive propaganda is shown by the suggestion of the Chief Inspector that a probable cause of " illumination shortcomings " is lack of technical appreciation, even more than apathy. " Proper—or improper—heating or ventilation is largely self-apparent; lighting is not. A knowledge of elementary principles is required for the essential discrimination be-

tween light provided and light made use of." Readers may be reminded that the Home Office have done what they can to draw public attention to the importance of the matter by the issue of a pamphlet on "Lighting in Factories and Workshops," which is procurable from H.M. Stationery Office, at the price of 6d. net.

Rubber for Pipe Joints

On later pages will be found an extract from a paper by Mr. K. R. Knapp, Chief Engineer, American Gas Association Testing Laboratory, on the use of rubber for pipe joints, and the information given on this interesting topic will prove of much service. Rubber compounds are excellent packing mediums because of their capacity to store up elastic energy when deformed. This property, of course, enables the rubber gasket to maintain permanently a pressure against its confining surfaces and keep the joint tight. A gasket compound should therefore have high resilience, and it should also have as low a compression-set as is possible without the sacrifice of other essential qualities. The author emphasizes that great care should be exercised in claiming any definite relationship between hardness and packing qualities, which must be balanced with the fact that hard compounds generally have better aging qualities and show greater resistance to the action of gas condensates.

As to the life of rubber joints, many available records attest to the fact that properly compounded gaskets can be depended upon to last as long as the pipe in which they are used. In the cases where failures have occurred, investigation has always shown that they were due in part to some unusual joint or service condition. Instances have been encountered where the service conditions had been unusually severe and the gasket used was not specifically compounded to resist the action of the pipeline contents. That gaskets failed under such conditions is not surprising. "On the other hand, with the many advances made in the art of rubber compounding and the improvements in the manufacture of both pipe and pipe joints, there is every reason to believe that a gasket developed for a particular service in a modern pipe joint can be expected to function perfectly during the entire life of the installation." This statement is considered justified in view not only of the generally satisfactory performance records of rubber gaskets in the past but because of the marked superiority of gaskets of present-day design over those of former types. Results of extended tests confirm the statement.

Personal

On the occasion of his golden wedding Mr. William Newey, who has seen 56 years' service with the Leamington Priors Gas Company, was the recipient of an inscribed gold watch presented to him by the Directors of the Company.

* * *

Mr. John Ellis Cowcill, of Silkstone Common, near Barnsley, has disposed of his interest in the Glow Coal Company, Huddersfield. This has been taken over by Mr. J. Woods Smith, who for the past thirteen years has been with the Modern Transport Company at their Leeds Office.

Obituary

The death occurred on Aug. 6 of Dr. Frederic Harry Haynes, a Director of the Leamington Priors Gas Company.

* * *

The death took place last week of Mr. James William Gardner, Chairman of the Directors of the Rugeley Gas Company, at the age of 85.

* * *

We regret to announce the death, after a brief illness, of Mrs. Miriam Vera Bennett, wife of Mr. Wm. Bennett, Engineer and Manager of the Mossley Corporation Gas Department.

News in Brief

First Prize in the Trade Exhibits at the local hospital carnival parade, held on August 3, was won by the Fleetwood Gas Company.

The Tender of Messrs. R. & J. Dempster, Ltd., Manchester, to supply three tar stills has been accepted by the Belfast Corporation Gas Department.

An Extension of Limits of Supply is one of the objects of a Special Order under the Gas Undertakings Acts, 1920 to 1934, for which the Harwich Gas and Coke Company intend to apply to the Board of Trade.

About 1,000 Street Lamps in Wembley are to continue to be lighted by gas for five years, an agreement for that period having been entered into by the Urban District Council and the Gas Light and Coke Company.

New Offices for the Belfast Gas Department will be provided at Tower Buildings, Ormeau Avenue, Belfast, which was formerly a linen warehouse. The premises are being altered to provide suitable accommodation for the offices which will be transferred from the City Hall.

Application for a Special Order is intended to be made to the Board of Trade under the Gas Undertakings Acts, 1920 to 1934, by the Dunstable Gas and Water Company, with the object, *inter alia*, of authorizing the Company to erect gas-works plant on certain lands in the Borough of Dunstable.

The New Gasholder at Southwold, which has a capacity of 80,000 cu.ft., was inaugurated on August 7, when Mrs. A. Critten, wife of the Chairman of the Southwold Gas Company, turned on the inlet valve and Mrs. G. Crick, wife of the Managing Director, lit a jet of the first gas to flow from the holder.

Tokyo Gas-Works.—In a recent number of the *Far Eastern Review*, a monthly magazine published in Shanghai, appears an informative article written by Mr. Walter T. Dunn, M.I.Mech.E., formerly Secretary of The Institution of Gas Engineers, under the title of "The Works of the Tokyo Gas Company, Ltd."

Stockport and Poynton.—To the last meeting of the Stockport Gas Committee, Mr. T. Reynolds, Engineer and Manager, reported that it was proposed to take over the Poynton supply from Oct. 1 next and that it was desirable to erect a temporary showroom. A sub-committee was appointed to deal with the matter.

A Reduction of 2d. per 1,000 cu.ft. in the price of gas has been decided upon by the Directors of the Montrose Gas Company, Ltd. The change now makes the price 3s. 10d. per 1,000 cu.ft. A similar step has been taken at Sanquhar, where a reduction in the price of gas by 5d. from 5s. to 4s. 7d. per 1,000 c.ft. has been decided upon by the Town Council.

The New Model Bakery at Albion House, Driffield, owned by Mr. W. B. Hodgson, who has secured many diplomas and awards for his bread at exhibitions up and down the country, is equipped with a Cox Super Heat-Trap oven built by Cox Ovenbuilders, Ltd., Birmingham, and a Richmonds thermal storage water heater supplied by the Great Driffield Gas Department.

A Crude Oil Explosion at a Cardiff bakery wrecked a big travelling oven capable of dealing with 700 loaves an hour on Aug. 12. Fortunately the regular staff had not come on duty at the time of the accident and there were consequently only two slight casualties. Coke-heated ovens were brought into commission immediately.

Mr. Samuel B. Chandler, M.Inst.Gas E., Distribution Superintendent, Tottenham and District Gas Company, delivered an address at the weekly meeting of the Southgate Rotary Club on "Town Gas in Industry" with special reference to long-distance transmission, the "Gas Grid," the services of the Gas Industry to the industrial consumer, the function and application of industrial centres, and the methods adopted whereby gas may be applied more efficiently to manufacturing units (bakers' ovens, enamelling plant, &c.). Photographs were exhibited detailing plant installed in the Tottenham district.

A New **Company**, the Brancepeth Gas and Coke (Strakers & Love), Ltd., has been formed to carry on the by-product plant being started at Brancepeth Colliery by Messrs. Strakers & Love, Ltd., Durham colliery owners. As mentioned in these columns last week, a start has already been made with the erection of the coke ovens and other plant. The nominal capital of the new Company is £115,000 in £1 shares.

A **Contract** has been secured by Gas Chambers and Coke Ovens, Ltd., of Artillery House, Westminster, S.W. 1, for an installation of C.O.L. intermittent vertical chambers at the South Melbourne Works of the Metropolitan Gas Company of Melbourne. The capacity of the plant will be 2,000,000 cu.ft. of gas per day, and the contractors inform us that it is the largest installation of intermittent vertical chambers yet ordered for Australia.

High Prices for the Shares of the Willenhall and Bilston Gas Companies obtained at an auction sale held at Bilston on August 6 after some very keen bidding were as follows: Forty-nine £10, 5% Willenhall Gas Company shares were sold for £20 10s. per share; eight "A" £5 shares in the Bilston Gas Light and Coke Company realized £13 10s. each, and twenty "B" £5 shares in the same Company were sold for £10 2s. per share.

Reductions in the Prices charged to consumers for gas were agreed on as follows at a meeting of the Finance Committee of the Perth Town Council: The rate of 3s. 3d. per 1,000 cu.ft. up to 15,000 cu.ft., per annum, to be reduced to 3s. 2d. The rate of 2s. 11d. charged over 15,000 cu.ft. to be reduced to 2s. 8d. The industrial rate of 2s. 11d. per 1,000 cu.ft. to be reduced to 2s. 6d. and the public lighting rate to be reduced from 2s. 6d. to 2s. 1d. per 1,000 cu.ft. The changes represent an annual saving of £3,515 to the consumers.

Carnival Time is in full swing once more, and the Gas Light and Coke Company have found a new use for their mobile showrooms when off duty. They have been appearing at Carnivals in decorated van competitions and running away with prizes. They have won 1st Prizes at Feltham and Acton; 2nd Prize at Billericay, and 3rd Prize at Hanwell. Most of the competing entries wore frills and furbelows, but the G.L.C. vans disdained trimmings and motored through in the simple but snappy costume designed and executed for them by the Display Section of the Company's Gas Sales Department. At Falmouth on Aug. 3, where there were 220 entries in perhaps the biggest and most brilliant show the town has seen, the Falmouth Gas Company won first prize in the class for the best trade advertising exhibit.

A **Subsidiary Showroom** for their Gas Department was recently opened by the Southport Corporation at Liverpool Road, Ainsdale. The premises are of modern design and will be floodlighted by gas at night. Mr. J. H. Clegg, Engineer and Manager of the Gas Department, said that a recent analysis made by a large American Psychological Association, revealed the astonishing fact that something like 50% of customers close their accounts with various business firms because of the lack of interest and attention on the part of the companies or their salesmen. Such figures should make even public utility undertakings wake up to the fact that their customers are human. "We realize that very few people ever complain about the service for the very fun of doing so; their troubles, which might appear trivial in our sight, are big ones to them, and it is our place to act accordingly in a courteous, kindly, and service-rendering way."

Forthcoming Engagements

Sept.

5.—B.C.G.A.—Yorkshire District Conference at Bradford.

9-12.—Association of Public Lighting Engineers.—Twelfth Annual Meeting and Conference in London.

12.—North British Association.—Annual Meeting at St. Andrews.

19.—Wales and Monmouthshire Association.—Autumn Meeting at Porthcawl.

19.—S.B.G.I.—Council Meeting at 11 a.m.

28-Oct. 1.—B.C.G.A.—Annual General Meeting and Conference at Edinburgh.

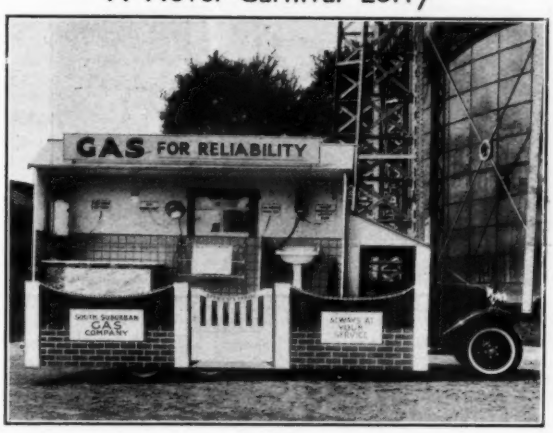
N.B.—There will be no meeting of the Central Executive Board of the National Gas Council or of the Central Committee of the Federation of Gas Employers during the month of August.

Amalgamation and Grouping

Gas Consolidation and Rugeley.

Messrs. Dawnay, Day, & Co., Ltd., announced on Aug. 6 that their recent offer to the stockholders of the Rugeley Gas Company on behalf of Gas Consolidation, Ltd., has been accepted by the substantial majority of the stockholders of that Company.

A Novel Carnival Lorry



This very striking display has been arranged by the South Suburban Gas Company for local Carnivals and similar events during the current season. As will be seen from our photograph, the motor lorry depicts "Efficiency House," which contains on the one side gas water heating and bathroom equipment generally, and on the other a model kitchen with enamelled cooker, wash-boiler, iron, refrigerator, and multi point heater. Attractive lighting fittings and slogans complete this novel display, which has created considerable interest in the districts visited.

Mobile Showroom Provides Excellent Display

A mobile showroom, plus some "trimmings" to give the appropriate effect, provided a splendid entry for the Chertsey Gas Consumers' Company in the local Carnival. Similar vehicles are being used by the Gas Light and Coke Company with considerable success in other Carnivals, prizes having been won by them at Feltham, Acton, Billericay, and Hanwell.

Durham District (Coal Mines) Scheme, 1930

Captain Harry Crookshank, M.P., Secretary for Mines, announces that under the powers conferred upon him by Section 1 of the Coal Mines Act, 1930, he has approved amendments of the provisions of the Durham District (Coal Mines) Scheme, 1930, in regard to the method of determination of inland supply and export supply standard tonnages, and he has appointed Aug. 12, 1935, as the date from which the amendments shall be operative.

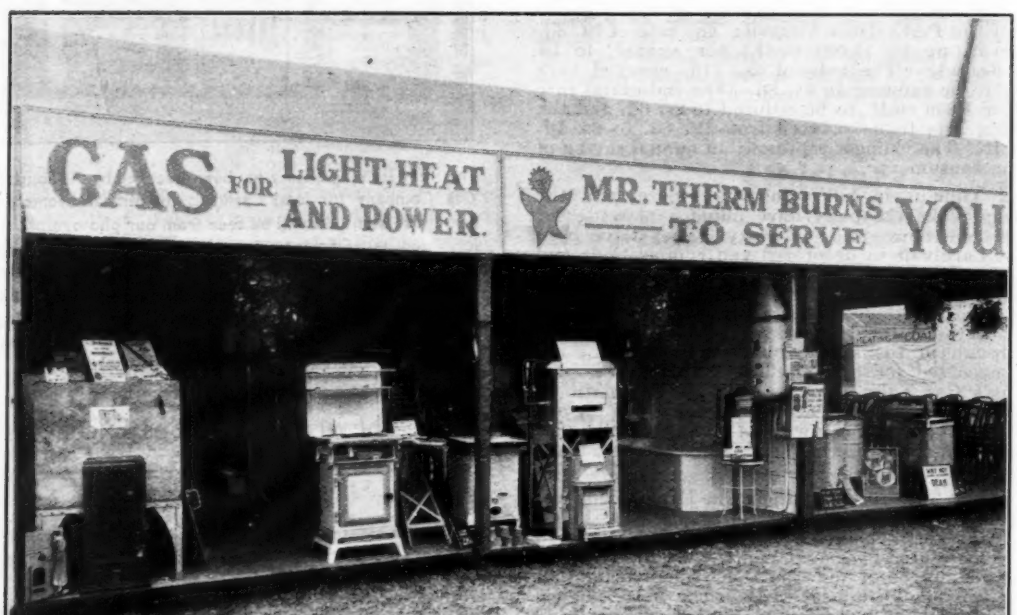
The text of the amendments of the Scheme as approved was published in the *London Gazette* dated Aug. 13. Copies of the amendments will shortly be available for purchase from H.M. Stationery Office, or can be ordered through any bookseller.

Gas Plays Prominent Part

IN THE

Great Yorkshire Show

The Sheffield Gas Company, as will be appreciated from the accompanying photographs, had a striking display at the Great Yorkshire Show at Sheffield last month. Great interest was taken in the gas cookery and washing demonstrations held on the stand. The Company were also responsible for the installation of the gas supply for catering purposes and for use on various stands, while the lighting of the Pavilion and Restaurant was also carried out by them. It is estimated that each day of the Show over 3,000 lunches and 4,000 teas were prepared and served.



The Portsmouth-Gosport Merger

Shareholders Give Approval to Scheme

Approval of the proposals for amalgamation with the Gosport District Gas Company, to which reference was made in the "JOURNAL" for July 17, was given at a general meeting of the Gosport stockholders, and at a meeting of the Portsmouth Company.

The Chairman of the Portsmouth Company (Mr. T. H. F. Lapthorn, J.P.) was unable to be present on account of illness but wrote to say he was glad, before being taken ill, to see the negotiations for the amalgamation brought to a satisfactory conclusion.

In the absence of Mr. Lapthorn, Mr. W. Gillman, J.P., explained that the Special Board of Trade Order, which was necessary to give effect to the terms of the provisional agreement entered into between the Companies, provided for the transfer of the Gosport Company from Jan. 1 next, or a suitable date beginning a quarter or half-year, April 1 or July 1. The name of the amalgamated undertaking would be the "Portsmouth and Gosport Gas Company," and the amalgamated Company would have a total capital of £1,373,740, of which £1,092,509 would represent the Portsmouth Company and the balance of £281,231 the Gosport Company.

It was a condition of the merger that one of the Gosport Directors should join the Board of the combined undertaking, and that the other five should receive compensation for loss of office equal to seven times the amount of fees received by them, the auditors to receive a sum equal to three times.

Provisional arrangements had been made for the engagement of the two chief officials of the Gosport Company—the Engineer and General Manager and the Secretary—while all other regular members of the staff and employees would be taken into employment in suitable positions.

It was intended, said Mr. Gillman, that the price of gas throughout the Gosport area of supply should, as from the date of transfer, be immediately reduced by 1d. per therm, and the present reduced scale of prices to large consumers at Portsmouth would also be applied in the case of the Gosport consumers. The economies which would be effected as the result of co-ordinated control would offset the cost of this price reduction. Compared with the present selling price of 7d. per therm in the City of Portsmouth, the price of gas in the Borough of Gosport would be 8·4d. per therm.

Mr. Gillman also informed the meeting that the combined Undertaking would have 90,000 consumers with a consumption of 3,300 million cu.ft., and the area of supply would be nearly 200 square miles with a population of nearly 350,000.

He moved a resolution that the provisional agreement should be approved.

Captain Baker seconded, and the resolution was carried unanimously.

Approval was also given to the Draft Order.

THE USE OF
Gas Heaters in Flueless Rooms

The following Interim Report of the Medical Advisory Committee is reprinted from the Aug. 10 issue of the *British Medical Journal*.

The modern practice of building dwelling rooms without flues is a matter of concern to the medical profession, not only because doubts have been expressed as to the hygienic sufficiency of the ventilation of such rooms, but also because the warming of them by flueless gas heaters has been regarded with some suspicion.

As a result of a request from the Governor of the Gas Light and Coke Company for advice and assistance on this matter, the Royal College of Physicians approved the formation of a Medical Advisory Committee, on the nomination of its President, to examine available information, to initiate such research as may be thought necessary, and to make recommendations. This Committee was constituted as follows: Sir Joseph Barcroft, F.R.S., Professor of Physiology, University of Cambridge; Dr. Guy P. Crowden, M.Sc., Reader in Industrial Physiology, University of London, London School of Hygiene and Tropical Medicine; Sir Arthur J. Hall, F.R.C.P., Emeritus Professor of Medicine, University of Sheffield; Dr. Reginald Hilton, F.R.C.P., Assistant Physician, St. Thomas's Hospital; and, as Chairman, Professor W. W. Jameson, F.R.C.P., Professor of Public Health, University of London, Dean of the London School of Hygiene and Tropical Medicine.

The Committee has held several meetings and has examined a large amount of published and unpublished information, as a result of which it feels that, while more work requires to be done in certain directions, a short note giving the results of some of its enquiries may be of service at the present time, and, pending the preparation and publication of a full report, it agrees to the following summary of its interim conclusions. It should be noted that these conclusions refer only to conditions likely to be found in living rooms and bedrooms, and are not necessarily in any way applicable to those met with in factories and workshops.

Ventilation.

In a room unprovided with a flue the ventilation depends so much upon uncertain factors, such as the strength and direction of the wind, that it is difficult to generalize on the degree of ventilation which is normally obtained. Doors and windows are often kept closed, and air bricks, if present, rendered ineffective, especially in the absence of any obvious provision for the (economical) warming of such rooms. It has usually been assumed that, in ordinary flueless rooms without an air brick, and with doors and windows shut, an air change of at least 1/2 per hour is obtained, mostly through chinks round the door and window frames. Reliable evidence on the subject is limited, but the Committee is inclined to believe that this figure is an underestimate, and that at least in small rooms not exceeding 1,000 cu.ft. capacity the air change will rarely be below 1 per hour. Quite apart from heating, and whatever the heating medium, it is, however, open to grave doubt whether an air change of 1 per hour in an occupied room is high enough to ensure healthy and comfortable conditions. Because of the existing uncertainties the Committee hopes to arrange for the carrying out of additional experimental work of a practical character on this problem.

Heat Requirements.

The less the degree of ventilation the less will be the quantity of heat necessary in cold weather to maintain a comfortable temperature. With flueless gas heaters all the sensible heat from the burning gas passes into the room, either as radiant or as convected heat. It appears that for average conditions an allowance of about 1 cu.ft. of gas (500 B.Th.U.) per 100 cu.ft. of room capacity would be sufficient to maintain comfort if the gas heater were in continuous operation. In practice such heaters are more often used intermittently, and for the rapid warming-up of a cold room a more powerful heater is therefore desirable. If such a heater is used for a prolonged period of time at the full gas rate the room would almost certainly become overheated, with the result that then the occupants would probably either turn down the gas or open the windows. For practical purposes it may therefore be desirable to suggest a maximum gas rate for flueless gas heaters of 1 cu.ft. per hour per 50 cu.ft. of room space, which will allow rapid heating-up of the room and will fix a limit to the degree of overheating which is possible.

Products of Combustion.

Although the composition of town gas may vary considerably in different areas of supply, the products of combustion always consist almost entirely of water vapour and carbon dioxide. (There are also minute traces of sulphur oxides, nitrogen oxides, and carbon monoxide, which are referred to later in this summary.)

Water Vapour.—About 1 cu.ft. of water vapour is produced from each cubic foot of gas burnt. The effect on the air of the room will be to increase its humidity, a result which may often be hygienically beneficial.

Carbon Dioxide.—About 0·5 cu.ft. of carbon dioxide is produced from each cubic foot of gas burnt. A good deal of misunderstanding still exists in the public mind with regard to the supposed harmful effects of carbon dioxide. This is probably owing to the fact that its concentration has for long been used as the gauge of the vitiation of air in dwellings. It is certainly a useful index of the dilution of room air with fresh air—that is, the air change in rooms—but actually there is no evidence that concentrations of carbon dioxide much greater than those encountered in overcrowded rooms have any deleterious effects. Furthermore, it may be pertinent to point out that as much as 5 or even 7% of carbon dioxide is commonly used as an inhalation for the resuscitation of cases of asphyxia. The concentration of carbon dioxide in the air of a room due to the combustion of coal gas in a flueless gas heater operated at the gas rates suggested is calculated to be below 1%, even when a certain degree of overheating is being experienced.

It may be concluded, therefore, that hygienic conditions will not be adversely affected by these two main products of combustion—namely, water vapour and carbon dioxide—in flueless gas heaters.

Nitrogen and Sulphur Oxides.—When undesirable overheating is caused by flueless gas heaters physical discomfort may be accompanied by a pungent smell or irritation of the throat due to traces of oxides of nitrogen and sulphur which are produced by the burning gas. Nitrogen oxides are produced to the extent of about 5 cu.ft. per 10,000 cu.ft. of gas burned, of which less than half a foot will be nitrogen peroxide—the only one of the nitrogen oxides of physiological significance at low concentrations. Even when overheating is taking place this oxide will be present in the room air at far below its limit of perceptibility, and there is no evidence that any concentration which is likely to be reached under the practical conditions suggested would be physiologically harmful. Of the sulphur oxides both the trioxide and the dioxide are present in the products of combustion of coal gas, the proportion, varying according to circumstances, rarely exceeding 1 of trioxide to 4 of dioxide, while the total amount depends upon the sulphur content of the gas burned and the degree of absorption of the oxides by the walls, &c., of the room. Sulphur dioxide is just perceptible in the air at a concentration of 2 parts per million, while the mixed oxides may be perceptible at half this concentration, owing to the greater perceptibility of the trioxide. While there is some evidence that prolonged exposure to 10 parts per million of sulphur dioxide may produce nasopharyngitis and interference with smell and taste, it is also on record that air containing up to 40 parts per million can be breathed for six hours without injury. Even when the higher toxicity of sulphur trioxide is taken into account it is clear that the room will be overheated, and the air will acquire a perceptible smell, before it has become sufficiently contaminated to be harmful. The presence of the pungent smell in association with overheating conditions cannot, however, be accepted as desirable from the point of view of comfort or health.

Carbon Monoxide.—This gas has no smell, and, owing to its power of combining with hæmoglobin, is dangerous. It is incorrect to suppose that it is normally present in

harmful quantities in the products of combustion. The Committee has examined a large amount of experimental and statistical evidence, which shows that any fears of carbon monoxide poisoning from flueless gas heaters as normally used are without foundation. There must be some serious defect in the appliance or in its installation for carbon monoxide to be produced in harmful amounts. The production of carbon monoxide from normal flueless gas heaters is less than 1 cu.ft. per 1,000 cu.ft. of gas burned, which under conditions of overheating might lead to a concentration in the room air of 10 parts per million, or one-tenth of that which is the safe limit for industrial workers under conditions of continuous exposure.

Summary.

The Committee has examined all the available evidence on the ventilation of flueless rooms and the warming of them by flueless heaters. Since the air change in such rooms may be as small as 1 per hour, it is open to serious doubt whether a degree of ventilation of this low order can be regarded as satisfactory whatever the nature of the heating, and whether this modern tendency in housing construction is, from the point of view of health and comfort, in the best interests of the community. More information is needed on this subject.

Any form of heating in small unventilated rooms which tends to lead to accumulations of hot stagnant air is objectionable. In this respect flueless gas heaters are no better and no worse than alternative appliances. Any risk in health from the inhalation of products of combustion from flueless gas heaters is discounted by the fact that, even with an air change as low as 1 per hour, discomfort from overheating would be experienced long before harmful concentrations of such products would be reached.

The Finance Act of 1935

A Summary of the Provisions as Affecting Gas Undertakings

The Chancellor of the Exchequer introduced his Budget on April 15 and the Finance Bill which was subsequently brought in received the Royal Assent on July 10—in substantially the same form. It is probable that the long-promised Report of the Departmental Committee on the Simplification and Consolidation of Income-Tax Legislation—which was appointed in 1927 and is expected to present a measure to this end during the current year—has resulted in the exclusion from the present Statute of any considerable amendment of the Income-Tax Acts, 1918 to 1934.

Part I.—Customs and Excise.

Sixteen sections under this heading are enacted to amend the rates and conditions of duties in respect of heavy oils, vehicle duty, and other matters.

As from Aug. 8 next, the rebate of 7d. per gallon allowed in respect of heavy oils (Finance Act, 1933, *Section* 6) will be withdrawn in so far as such oil is used for mechanically propelled vehicles "constructed or adapted for use on roads" (*Section* 2).

The Chancellor was careful to emphasize that the withdrawal of this differentiation was not in any way prompted by a desire to impede the development of diesel-engined road vehicles, but rather to obviate the threat of a loss to the Exchequer of an annual sum exceeding £2,000,000. The significance to the Gas Industry of this was elaborated in the "JOURNAL" for April 24 (p. 197).

During the Committee Stage of the Bill a proposal was made that a rebate of 7d. per gallon should be extended to light hydrocarbon oils used *industrially*—thus placing them in the same position as heavy oils—but the clause was negatived.

The licence duties payable in respect of "heavy oil" vehicles are reduced, as from Aug. 1 next, to the scale applicable for "petrol" and "coal-gas" vehicles (*Section* 3). This scale is set out in the Seventh Schedule to the Finance Act, 1933 (Part I., paragraph 3 (*b*)). The licence duties in respect of goods vehicles using "heavy oils" are also amended (*Section* 3 (2)). As an example, by virtue of the Second Schedule to the Finance Act, 1920 (as amended by the Seventh Schedule to the Act of 1933—Part III., paragraph 5 (*c*)) the respective duties were as under:

Exceeding 2½ tons, but under 3 tons in weight unladen (fitted with pneumatic tyres):

	£
(i) Electrically propelled	30
(ii) Propelled by steam or by coal gas	35
(iii) Propelled by light oils (*i.e.*, petrol)	35
(iv) Propelled by heavy oils	45

As from Aug. 1, those vehicles now in class (iv) are assessed on the basis of class (iii), but it should be pointed out that, while the rates of duties for other weights are, generally, in proportion, this does not apply throughout the Schedule.

It will be remembered that when the duties were revised by the Act of 1933 it was originally proposed that vehicles using coal gas as fuel should pay a higher rate than those propelled by steam, but that this distinction was amended on the Report Stage ("JOURNAL" for July 12, 1933, p. 90).

A proposal to reduce by 25% the licence duties on heavy commercial motor vehicles—to counter, in some measure, the effect of the increased duty imposed on diesel-oil engines—was heavily defeated both on its merits and by reason of the consequent loss of revenue to the Government's Road Fund.

As from Jan. 1 next, the classification of certain vehicles for the purposes of licence duties is amended by excluding from the "unladen weight" of the vehicle the weight of any machinery or contrivance built therein and which is the sole load of the vehicle (*Section* 4 (1)). In these notes last year (July 25, 1934, p. 207) reference was made to the fact that gas-propelled vehicles suffered a disadvantage, as compared with petrol-driven vehicles, by reason of the weight of the coal-gas containers being included in the "unladen weight" for the purposes of this duty. It would seem eminently reasonable that the concession conferred by *Section* 4 (1) should be extended to vehicles propelled by coal-gas.

When the Bill was in Committee, an amendment to these classifications was successfully moved in respect of vehicles used in connection with "excavating or shovelling work" (*Section* 4 (3)).

Part II.—Income-Tax.

The allowance for repairs (under Schedule A—applicable in certain instances to gas showrooms, &c., separately assessed under that Schedule and not properly included in the assessment of the undertaking under Schedule D) as provided for by *Section* 28 of the Finance Act, 1923, is continued in operation for the fiscal year 1936-37. The fact that this is for one year only, whereas previously it has been customary to re-enact the provisions for a term of years, would appear to indicate a contemplated change in the method of assessment under this Schedule to be recommended by the Departmental Committee (*Section* 24).

Rationalization of Industry.

In the previous year it was observed that a clause had been introduced in the Finance Bill of that year to deal with a matter (the repeal of the Land Value Tax) which had not been incorporated in the Chancellor's Budget Speech. On the present occasion it was noticeable that a provision for the deduction from profits assessable under Cases I. and II. of Schedule D to the Act of 1918 of contributions paid to rationalize an industry was not foreshadowed by the Chancellor of the Exchequer and much adverse criticism was no doubt occasioned thereby.

The provisions (*Section* 25) enact that this deduction shall be permitted in respect of a contribution paid in furtherance of a scheme which is certified by the Board of Trade as—

(*a*) having as its primary object the elimination of redundant works, machinery, or plant from use in an industry in the United Kingdom (a proviso to *Sub-Section* (2) was added on the Report Stage of the Bill to prevent this definition excluding shipowners who could not be said to be carrying on business entirely in the United Kingdom),

(*b*) being in the national interest and in the interest of the particular industry as a whole, and

200
W-D WASTE HEAT BOILERS

INSTALLED OR
BEING INSTALLED
IN CONJUNCTION WITH

HORIZONTAL
AND CONTINUOUS
& INTERMITTENT
VERTICAL
RETORT SETTINGS

W-D

In 1917 Woodall-Duckham pioneered the use of waste heat boilers with **Continuous Vertical Retorts**

In 1918 the Woodall-Duckham Horizontal Firetube Waste Heat Boiler was designed

In 1922 Woodall-Duckham successfully applied waste heat boilers to **Small Retort Plants**

In 1924 Woodall-Duckham installed the first W-D Waste Heat Boiler to work in conjunction with **Horizontal Retorts**

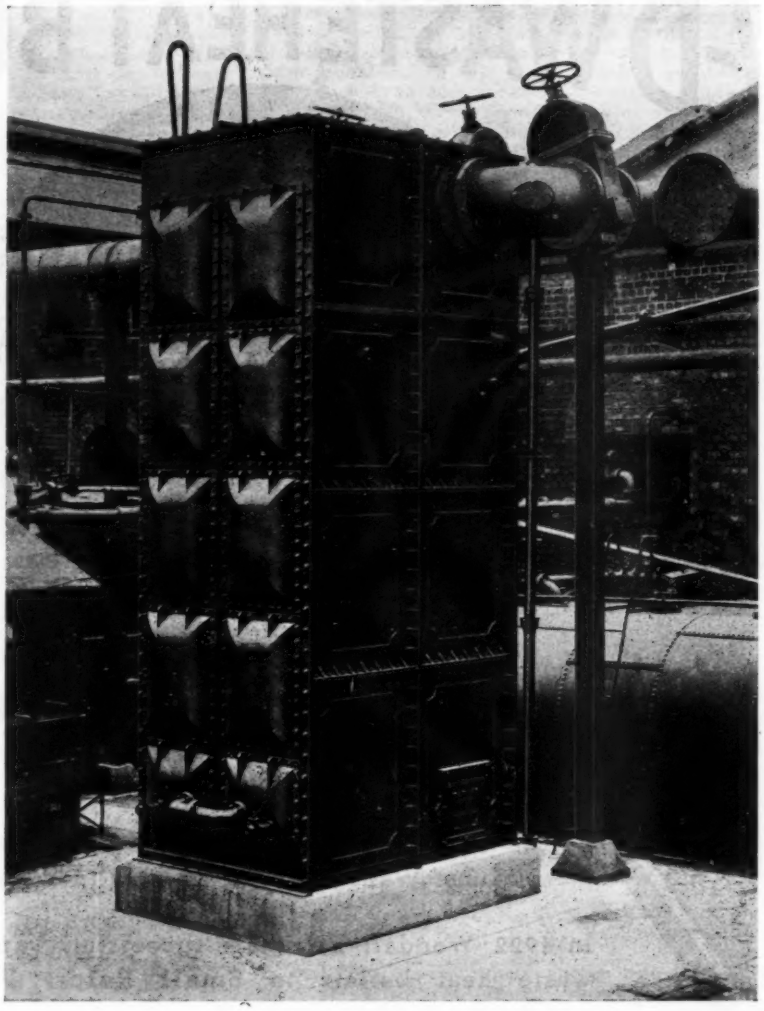
In 1925 Woodall-Duckham installed the first W-D Waste Heat Boiler to work in conjunction with **Intermittent Vertical Chamber** Settings

In 1927 Woodall-Duckham pioneered the commercial application of the principle of **"Augmentation of Waste Gases,"** whereby, so as to supplement the supply of waste gases, producer gas is diverted through a supplementary combustion flue for admixture with the waste gases on their way from the settings to the boiler

In 1928 Woodall-Duckham designed the W-D **Natural Draught** Horizontal Firetube Waste Heat Boiler specially for use with Small Retort Installations

In 1935 the **200th** W-D Waste Heat Boiler has been ordered and this is the **24th** to which the principle of "augmentation by producer gas" has been applied

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION CO. (1920) LTD., EBURY & ALLINGTON HOUSES, 136-150 VICTORIA STREET, LONDON, S.W.1
Members of the Society of British Gas Industries
Telegrams: "Retortical, Sowest, London" Telephone: Victoria 8631 (6 lines)



HORIZONTAL TUBE Water-cooled CONDENSER, capacity 2,000,000 cu. ft. of gas per day, erected at the KIDDERMINSTER GASWORKS.

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(*c*) entailing the payment of contributions in furtherance of the primary object of the scheme by agreement between a number of persons engaged in the industry (being substantially representative of the workers) and the body of persons carrying out the scheme.

Provision is made *inter alia* for the cancellation of a certificate granted by the Board of Trade (*Sub-Section* (3)) for the taxation of any such contributions repaid in a company's liquidation or otherwise (*Sub-Section* (4)), and for the consequential amendment of the treatment of losses, under *Section* 33 of the Finance Act, 1926, for tax purposes (*Sub-Section* (6)).

In the debate on this clause objection was taken to the fact that the powers conferred by the section on the Board of Trade might be exercised by "the President, a secretary, under-secretary, or assistant secretary of the Board or any person authorized in that behalf by the President of the Board" (*Sub-Section* (8)).

A memorandum accompanying the Bill stated that "the expenses falling upon the Board of Trade" in connection with the certification of rationalization schemes under *Section* 25 "will be negligible," but it was on the ground that this clause—while of general application—contained no provision for displaced workers in the particular industries it was desired to "rationalize" that the main objection was taken. To remedy the position it was moved that a condition of the approval of the Board of Trade to a scheme of rationalization for the purpose of tax remission should be that effective measures had been taken to ensure the re-employment of, or payment of adequate compensation to, any workpeople who might be displaced—in the same manner that provision was usually made for compensating displaced directors or officials and on similar lines to the practice in recent amalgamations in the coalmining industry and to the clauses inserted in the Acts relating to Electricity, Railways, Local Authorities, and London Transport.

The Government's reply was that the clause in the Finance Bill was in a different category as not being intended to deal with any one definite scheme—although at a later stage it was indicated that schemes would be formulated under the section in respect of redundant works and plant in the Textile and Shipping Industries—and that as the Board of Trade was "the highest permanent statutory authority" the House was not delegating its powers.

An amendment, moved on the Report Stage, to define the meaning of "rationalization"—which while not appearing in the text of the Bill appeared in the marginal note—by making it a condition of approval by the Board of Trade that it is "calculated to increase the production of the national wealth," was also rejected. The mover of the amendment characterized the clause as "deliberately designed to prop up the capitalistic form of society" and urged in support thereof that no scheme of rationalization—within the terms of the clause—would be put forward on behalf of the municipal trading services.

Unaccepted Clauses.

A proposal that the allowance made in respect of children over 16 receiving full-time education should be extended to children serving an unpaid apprenticeship to any trade or occupation was withdrawn and re-introduced as drafted by the Parliamentary draughtsman, but failed to secure the Chancellor's approbation and it was rejected.

Sir Basil Peto moved a clause to make provision for deduction from profits in respect of "inherently wasting assets," but no better fate was in store than that which it has met for many years past.

Section 18 of the Finance Act, 1932, authorized an addition of 10% to the wear and tear allowance and a renewed proposal that this additional allowance should be increased to 20% was again unsuccessful.

Three amendments were brought forward intended to augment and improve the conditions for wear and tear and for obsolescence under Rules 6 and 7 to Schedule D to the Income-Tax Act, 1918.

Irish Association of Gas Managers

Presidential Address of J. A. Rooney

Delivered at the Annual Meeting of the Association held at Jury's Hotel, Dublin, on August 13. A report of the business meeting and papers will be published in next week's issue of the "JOURNAL."

The President

I would like to thank you for the honour that has been paid to me, and to the works which I represent, in having elected me your President for the past year. I can assure you that I appreciate that honour very much, as the town of Drogheda which I represent is one of the oldest and most historic in the Irish Free State.

It has a very progressive Corporation which takes a deep interest in its Gas Undertaking.

The time was when our principal preoccupation was the extraction of the maximum number of cubic feet of gas from coal by the process of carbonization. We are still concerned to secure the maximum yield from the coal we carbonize, but now we think in terms of the products from the coal and not from gas alone. Coke, tar, and in some cases benzole, now enter into the economics of gas manufacture to a greater extent than ever before, and the Gas Manager takes as his criterion of efficiency not simply the make of gas per ton, but the salable yield of products from each ton of coal.

Another great change has been wrought by the introduction of stoking machinery working in conjunction with modern horizontal retorts, vertical retorts, both intermittent and vertical, and the chamber oven. Automatically operated water gas plants, suitable for both large and small works, have also played their part in lightening the burden of the Gas Manager on the production side of the business. It is safe to say that in no industry has the technique of the manufacture shown greater development than is the case with gas manufacture.

The position to-day is that when replacements, or extensions of plant are under consideration, there is a variety of processes at our disposal to meet every need, and when economic considerations permit, or compel, the installation of new plant, we are in the happy position of being able to put in plant which is almost automatic in operation, and which will yield guaranteed results. Without doubt, a great deal of credit for these improvements was due to the skill and enterprise of the contractors specializing in the manufacture of gas production plant, and I would advise those whose policy on all occasions is to accept the lowest tender for engineering plant, to bear in mind the spade work that has been done to improve the plant offered, and they are not, by accepting the lowest price, getting the most efficient plant or quality and service.

The effect of these improvements is to relieve the Gas Manager of much responsibility on the production side, and so leave him free to devote more attention to commercial matters. That is fortunate, for there can be no doubt that the paramount need of the Gas Industry is for the more effective marketing of its products.

The Coal Problem.

It is many years since Mr. Newbigging wrote the golden adage, "Keep up the heats of your retorts." This brings me to the subject of coals, which at the present time is the bugbear of all the members of our Association who

reside in the Irish Free State, where in the past two years we have had to purchase coals practically at the dictation of the Government. Up to the commencement of this year we could buy coals from foreign countries at whatever price we could get for them, without paying any customs duty on them, but if we bought British we had a customs duty of 5s. per ton to pay on them. Now we *must* buy British and pay the customs duty of 5s. per ton, and besides we are restricted to a quota. In many cases this has been a trouble to the managers of works as the quota allowed is almost below their requirements. Mr. Lemass, Minister of Industry and Commerce, is quoted in the *Irish Times* of June, 1935, as saying in the Dail: "In answer to Mr. Counihan, that this tax of 5s. was mainly a revenue tax, it was also a protective tax and would help the consumption of turf and native coals, though that was not the primary reason for it. The transport and other industries where coal was an essential of the manufacturing process were getting their coal supplies free of duty. Nobody in this country need pay the tax because there was native fuel available for household use."

Accusations have been made in the Press that the Railways and the Electricity Supply Board are receiving their coal supplies free of duty, but the gas companies, who use coals wholly as raw material, can get no redress in this matter, although every effort has been made to get the Minister to reconsider his decision. Of course, we are fighting the E.S.B. with all our might and main, but we should not be the only party using large quantities of coals to be victimized.

In the purchase of coals one must be particular to buy the best. The same freight must be paid on small as on large coals, and with the handling it gets during transit it is often small enough when we get it. The richer the coal the smaller should be the charges, otherwise the tar distiller will get what you should have in your gasholders. It behoves us in Ireland to be very careful in our selection, especially now that coals are so dear. First, it is necessary to know the volume of gas per ton; secondly, the quantity and quality of coke produced; thirdly, the impurities in the foul gas as affecting the question of purification; and lastly, the percentage of water in the coal as affecting the temperature of distillation, especially in the early stages of the charging and the gaseous and liquid product as well.

In small gas-works in Ireland, of course, we cannot do our own analysis of the coals, but why should we not buy on a reliable certificate not more than one year old? The certificates we get at present are often found to be very old and therefore useless. One of the best indexes to the proper temperature of distillation, is the quantity and the quality of the tar produced from a ton of coal. Would it not, therefore, be a good idea to form areas for buying coal on the co-operative plan? Better terms than we have at present would certainly be obtained and possibly cheaper freights. Of course, I am only throwing this hint out, and perhaps our Committee might take this matter up and see if it is feasible. The amount of customs duty which the Free State is drawing from coals is calculated at £600,000, to which Gas Companies have to contribute 12½%, which is a gift to our competitors.

Tar Dehydration.

Tar has now become an absolute drug on the market as far as the smaller works are concerned. A few years ago, very large quantities of tar were sold to county councils and municipal bodies for tarring roads; then came concrete and bitumastic mixtures for road making, and that was the end of our practical monopoly. To add to our discomfort in the Free State, the British and Northern Ireland governments have put an import duty of 1d. per gallon on all tar imported into them, and prices are so low that they practically only pay the cost of exportation.

There also seems to be a definite move on the part of various surveyors against coal tar for road dressing. Owing to the damp nature of our country and the proximity of the various rivers to the roads, if any fish are poisoned it is invariably blamed on dressing by road coal tar. Another thing which militates against us is that there is no tariff on Road Board tar coming into the country, so that if dumping takes place we cannot find an outlet for our supplies. This operates against many small gas-works going in for tar dehydration, for they have no guarantee of tenure for Road Board tar, the whole of the supplies taken by the local government department being given under one contract. Consequently, if a firm outside Ireland gets that contract, we should be unable to supply any for that year unless we made under licence from that supplier. Here seems to be a chance for amalgamation of small works to erect a central tar works to use up their stocks of tar by co-operation.

The one drawback to this, in my estimation, is that the Government want only one supplier. But surely legislation could be effected to get sectional portions of the country allotted for contracts.

Representations were made to the Ministry of Local Government, and there seems to be a ray of hope as far as getting Road Board tar used by county borough surveyors is concerned, for instructions have been issued by the Secretary of the Board to use more gas tar in dressing the roads when the opportunity can be found to do so. Every Gas Manager must become a canvasser for tar for roads, whether he dehydrates his own or not—so "get to it," as the Americans say.

The General Outlook.

At the present there is little but uncertainty about the position of Ireland. If the general outlook were better we could decide more easily on a course which would lead to prosperity, but all we get now is uncertainty—uncertainty with rumours galore. That must not deter us from doing all we can to keep our end up. We must be prepared to attack our competitors from every angle, keeping all the lighting we can and giving every attention to complaints and advancing every point in favour, with truth behind each statement and individual attention wherever possible.

Unlike the British Parliament, who have done something for the gas profession, the home politicians are doing nothing for us, but everything in favour of their already heavily subsidized Electricity Supply Board. Every opportunity should be taken to bring this matter of want of fair play before the community. Of course, we are not all so fortunate as to possess a showroom, but we can put advertisements occasionally in our local papers and the B.C.G.A. will help us with good matter.

I would urge you not to scruple to acclaim the virtues of gas by judicious advertising and to get on the road to look for new business. No town is yet at saturation point if you will only go out to get this business, especially when almost every town has now some housing schemes on hand.

Although our industry at the present time seems to be very hard hit, we must not lose heart, but go steadily forward with the interest of our consumers at heart, which will redound to our credit, and no doubt your future Presidents will have a more cheerful Address to give you when occupying the position I now hold.

The Future.

No one can tell what the future has in store for us, but it seems safe to say that, despite the worst that our competitors can do, the Gas Industry will continue to prosper as long as we adapt our methods to suit the changing conditions. It is not enough to say that gas is a good article and can render good service. We have to convince the public of that fact, and take such action as lies within our control as will ensure that it is a fact. The degree of success which we achieve in the future will depend upon the manner in which we interpret the motto "Sales and Service." We have long passed the stage where we sold gas: when our interest stopped short at the meter. Nowadays we have to go right into the home, the factory, or whatever it may be, and see to it that the customer is getting full value from the gas he buys. The Gas Industry, production-minded for many years, has now to change its tactics and direct attention to the selling of its products—not only gas, but coke and tar. But there are signs that the Industry is alert to that need, and in my opinion the future of gas will prove to be a triumph for solid merit against the rather hollow qualities on which our competitors are seeking public favour.

"Beware"

This is the title of a booklet of hints on the prevention of accidents, compiled by the National Home Safety Committee and published at twopence by the National "Safety First" Association at 52, Grosvenor Gardens, S.W. 1.

Mr. J. C. Walker, General Secretary of the B.C.G.A., has contributed an article on the safe usage of gas appliances, in which he explains that there is no reason why the use of gas should not be wholly free from even small risks, and indicates a few simple precautions that consumers can take to combine complete safety in their homes with the many advantages which gas can give them.

The reader is given the impression that he, or she, has to be pretty stupid to come to any mishap by the use of gas appliances, which, as we know, is perfectly true. Mr. Walker's article is, therefore, wholly admirable.

The Marketing of Coke

by
F. M. H. TAYLOR

The Domestic Coke Boiler

Mr. F. M. H. Taylor, Ph.D., M.I.H.V.E., M.Inst.Fuel, continues his series dealing with specialized phases of the gas coke market, other contributions to which by the same Author have appeared in previous issues of the "JOURNAL."

While the open grate and coke boiler are utilizing increasing quantities of coke year by year, the Gas Industry's leaders point from time to time to the 40,000,000 tons of domestic coal consumed annually, the whole of which represents a potential market for gas or coke. The majority of domestic fuel is consumed in the open fire-grate, but a large proportion certainly belongs to the sphere of water heating, and the rapid advance during the last 10 years of the domestic hot water boiler gives clear proof of this development.

Some 200,000 to 300,000 new coke boilers are installed every year in this country, representing an increased consumption of approximately 500,000 tons of graded coke, and of this probably 200,000 tons increase occurs in the London area.

While the London companies, and those in cities with large residential areas, find it necessary to cut large coke to fulfil demands of the domestic boiler, gas companies in outlying districts have found hitherto an insufficient use for the smaller grades of coke which are screened from the larger variety, and the expansion of the domestic boiler market proves a fruitful field for utilization of the smaller coke.

Another aspect of the very rapid expansion of the coke boiler trade is that, whereas in 1921 there was one manufacturer of an approved coke domestic boiler, there are now 40 well-known manufacturers, and 194 different types of boiler, and they are marketed by heating engineers, small jobbers, builders' merchants, and speculative builders. Many people having entered the field, the problem now is one of preventing an exploitation of the market, and the limitation as far as possible of the business to those manufacturers who make a satisfactory boiler in which coke will burn to the maximum satisfaction of the users.

It is interesting to note that more than 85% of the fuel used in the boilers now installed is coke, the remaining 15% being anthracite and semi-coke.

Various Types of Hot Water Boiler.

There is little variation in principle and method of operation among the forty or more different makes of domestic boiler. A few have combined ovens and grillers with some success, although it is generally recognized that a universal provider of heating, cooking, grilling, boiling, and water heating is out of the question. The majority of the boilers do make some provision for opening the front to give an open fire effect, and allow the boiler to be used as a room heater in the kitchen, and at the same time be sufficiently attractive for sitting by. All the well-known types are of very simple construction, a cylindrical or rectangular box with a waterwall of approximately 2 in. width. A supply of fuel for several hours' firing is added at one time to the boiler, usually filling the fire pot completely.

Boilers vary considerably in finish; the majority are supplied in very attractive coverings, such as white and mottled enamel; the domestic boiler now definitely enhances the appearance of the kitchen, and can be made to match any scheme of decoration.

Grate designs, and methods of handling the ashes, vary from boiler to boiler, most boilers incorporate some form of shaker or clinker crusher, and a few automatic controls are making their appearance. The gravity fed principle of construction has already been applied to the domestic boiler, and one or two models are now on the market, although the scope of the smaller type is somewhat limited.

Detailed Characteristics of the Domestic Hot Water Coke Boiler.

Materials of Construction.—The alternatives are cast iron and welded wrought iron or steel. Cast-iron boilers are cheaper, and they suffer corrosion to a much smaller extent when soft water is in use. With hard water the risk of scale deposition, subsequent overheating, and cracking, is too great for the cast-iron boiler, and here the wrought construction must be used, unless an indirect system is employed.

Grate Bars.—These must be designed to give the maximum air spacing, a minimum of 50% is preferable, and a suggested spacing of bars is $\frac{5}{16}$ in. Rocking, shaking, and rotating grates are in use, and these are now of a sufficiently efficient design and robust construction to justify their use, as the added convenience is of primary importance in the home, and the boiler gives much better results with a consistently clean grate.

Fuel Capacity.—Careful experiment has shown that the minimum fuel capacity for the domestic boiler should be about 0·5 cu.ft. The price-cutting war between the various manufacturers led to the placing on the market of a number of undersized models, which led to unsatisfactory service for the following reasons:

(*a*) The boiler was too small to give a sufficient supply of hot water to cover the needs of the household.
(*b*) The storage was too small to last overnight, and frequently necessitated relighting in the morning.

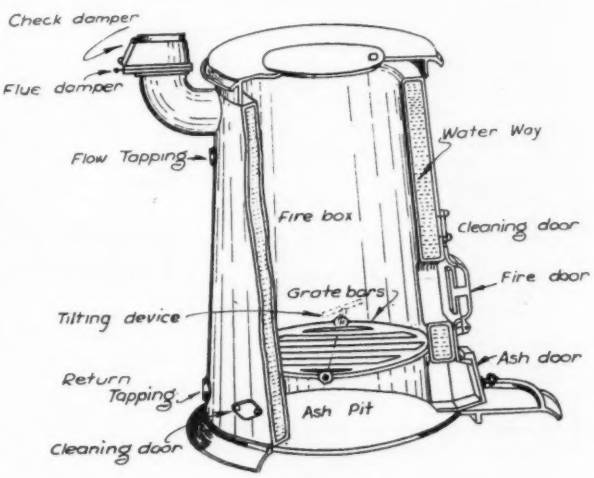

Fig. 1.—Diagrammatic sketch of a domestic coke boiler showing the various component parts. The tilting device of the grate bar is shown at 90° of the true position for the sake of clarity.

(*c*) Practically the whole of the fuel was within a few inches of relatively cold water surface, and unless the boiler was firing at relatively high ratings, there was a tendency for the fuel bed to lose temperature and die out. This is especially noticeable when two or three hours have elapsed since the cleaning period. From the coke suppliers' point of view the small boiler tended to favour the use of small anthracite, which is capable of maintaining combustion at slower rates, and lower fuel bed temperatures.

The Rating of Boilers.—The heating surface of the small domestic boiler is of primary importance, and the heat transfer is almost entirely by radiation from the hot fuel bed and the hot flue gases. In low and medium firing conditions this gives reasonably high heat transfer efficiency, but when the boiler is forced, up to 50% of the sensible heat in the flue gases may be lost up the chimney.

The boiler should provide 1 sq.ft. of heating surface for each 11,000 B.Th.U./hr. output, or where the boiler has a front which can be opened for use as an open fire, this figure should be reduced by 10%. If it is assumed that the domestic boiler has an efficiency under normal working conditions of 60%, 4½ sq.ft. of heating surface should be provided for each 1 cu.ft. boiler capacity. The rate of combustion per square foot of grate area varies from about 5 lb. per sq.ft. an hour to 8 lb. Generally, the very smaller sizes will run at a higher rate of combustion, since the

nearness to the waterways gives more rapid cooling of the fuel bed and allows a higher rate of combustion for the centre fuel bed temperature.

Cleaning.—The need for adequate fittings for cleaning holes cannot be too strongly emphasized. The writer only recently saw a boiler that had cracked after furring up solid, due to a small part of the boiler being inaccessible for cleaning through the inadequate provision of suitable cleaning plugs. Central heating boilers do not have a change of water, and there is not the same necessity for provision of cleaning holes. A thermometer should be fitted, as the extra cost of 10s. is more than repaid in the increased life of the boiler and the reduction in fuel consumption; the thermometer helps to avoid excessive overheating.

Dampers.—Besides the ashpit and flue damper, a check damper is an advantage. Sliding dampers should be graduated so that the operator can easily learn the fixed settings. Sliding dampers should not be a very tight fit, as the accumulation of dirt and scale on the surface soon causes sticking. Butterfly dampers should be fitted with an arm on the outside showing the position of opening. The butterfly damper and the check draught damper are more suitable for the application of automatic control, and the possibilities of the thermostat should not be overlooked in domestic installations. The ashpit damper should be of

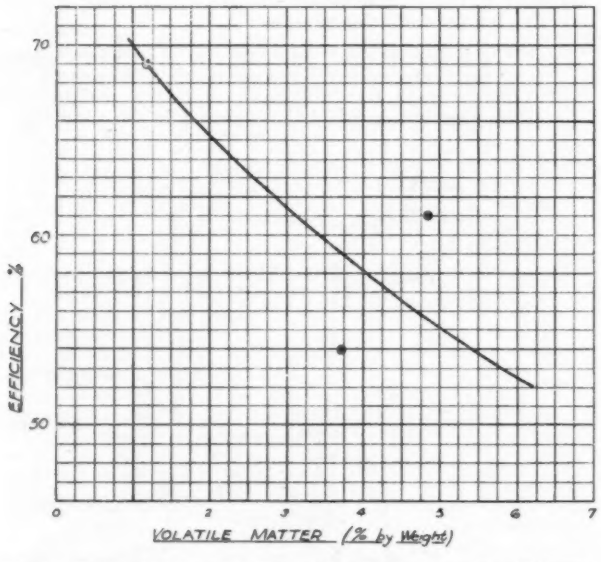

Fig. 2.—Graph showing the effect of volatile matter on the efficiency of the boiler. The figures are for relatively low rates of combustion.

an accurately machined fit to avoid any leakage of air when the boiler is supposed to be closed down to a low rating.

The Gas Poker.—The boiler should always be fitted complete with gas poker, as convenience in rekindling the boiler is a large factor in the satisfaction that the installation can give to the owner. In order to accommodate the poker a hole 1 in. in diameter with a hinge covering flap should be provided in the boiler front.

The general features of the boilers described in this contribution have recently been set out in a specification with supplementary recommendation for the coke domestic hot water boiler drawn up by the London and Counties Coke Association and newly formed Association of Domestic Boiler Manufacturers.

Perhaps one of the most important results of this work has been the discouragement of the under-sized domestic boiler, which was doing more than anything else to detract from the popularity which the boiler has justifiably enjoyed.

The Automatic Domestic Coke Boiler.

The simple type of thermostat fitted to the check draught damper gives a reasonably adequate regulation temperature and is a definite saving in fuel consumption. The cost of the installation, however, is high in comparison with that of the boiler itself. The domestic boiler gives such satisfactory service that it is doubtful whether there is any need at the moment for the application of automatic controls.

The hopper fed boiler principle has also been applied to the domestic coke boiler, but here again the extra cost barely justifies the increased convenience and saving in running costs. Of paramount importance is the rapid development of attractive and easily installed gas appliances, and the introduction by the gas undertakings of lower charges for gas used for water heating, makes gas the more suitable alternative to the householder who wishes an automatic provision for his hot water supplies.

Characteristics of Domestic Fuel.

The need for a satisfactory design of boiler has been emphasized, but after the boiler maker has done his part it is necessary for the gas undertakings to supply a first-class fuel having, as its maximum object, to ensure flexibility in operation, and the ability to operate for long periods without attention.

Size.—The most universal is from $\frac{5}{8}$ in. to $1\frac{1}{2}$ in., and boilers of 20,000 to 30,000 B.Th.U./hr. give better results on an even smaller grade—$\frac{1}{4}$ in. to $\frac{3}{4}$ in.

Small fuel gives better flexibility, and allows the boiler to run generally for longer periods, but it creates the difficulty that small pieces drop through the grate bars.

Closeness of grading has been shown to have a very small effect on the flexibility of the boiler, but the tendency of coke to segregate during handling prevents any wide range in the divergence in the grading, desirable though this would be for the producer.

The effects of size of coke and of closeness of grading on the flexibility of the boiler are shown in the two tables.

The Effect of Size of Coke on Flexibility.

Grade.	Flexibility.	Maximum Period of Combustion.
In.		Hours.
2 –1	*Nil*	8
1½–1	*Nil*	8
1 –⅝	1–2	9
¾–½	2	11
⅝–⅜	4	16
½–¼	7	24

The Effect of Closeness of Grade on Flexibility.

Grade.	Flexibility.	Minimum Damper Opening for 8½ Hours' Combustion.
In		In.
1–⅝	1	⅜
¾–½	1	⅜

In the matter of clinker formation, the larger the fuel the less likelihood of trouble from this source, except that, when a large ungraded coke is used, ash which has segregated in carbonization, or has been introduced as shale, and which has not separated on breaking of the coke, forms a nucleus, on which clinker begins to form in the boiler.

Volatile Matter.—The volatile matter of the coke usually varies from 0·8% to 3%, and generally the higher the volatile content the more satisfactory to the consumer is its use, although it is more extravagant from the Gas Industry's point of view, entailing, as it does, a lower yield of gas. The boiler will generally run at longer periods, and lower rate of output, with less attention to the grate, and will pick up more quickly from a slow fire, when coke is used with a large volatile content. It is also much easier to re-kindle the fire. On the other hand the volatile matter in the coke is apt to give a sooty deposit in the flue, and to result in a reduced boiler efficiency under normal conditions of operation.

These conclusions are not only based on general experience in normal use, but they have been proved by tests carried out under carefully regulated conditions.

The lighting-up time for the coke boiler has been shown to be in inverse proportion to the volatile content of the fuel. Similar tests have measured the pick-up time of various cokes under slow firing conditions. As given in the table, the pick-up time is approximately in inverse ratio to the volatile content. The pick-up time may be taken as a measure of the flexibility of the fuel.

An interesting series tested the effect of the addition of a small percentage of fuel of high volatile content, and showed that the lighting-up time of the high-temperature coke could be reduced to a third normal by the addition of 10% of low-temperature semi-coke.

The effect of volatile matter on efficiency is also note-

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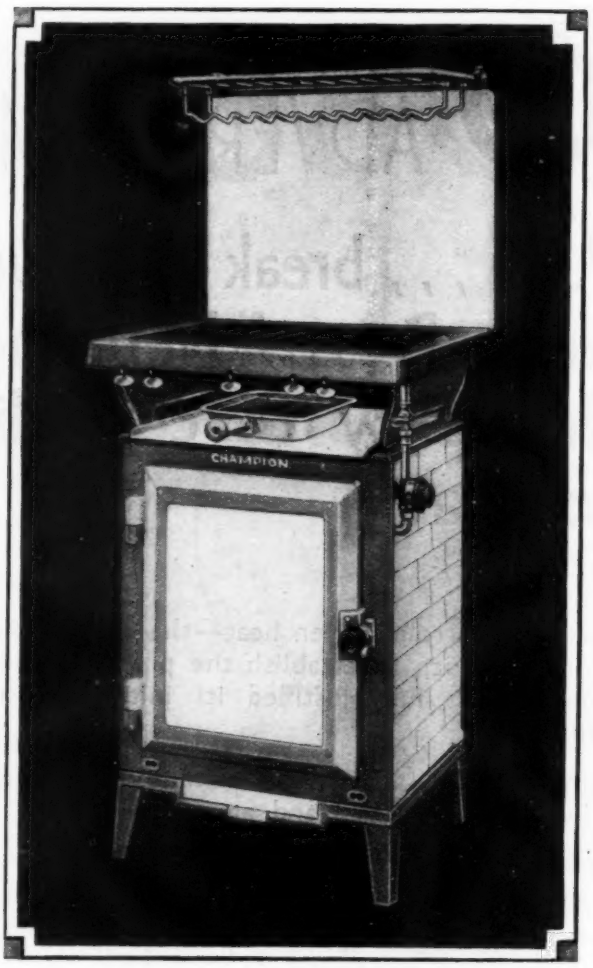

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worthy, and the following table represents the summary of tests:

Fuel.	Volatile Matter. Percentage by Weight.	Rate of Combustion Lbs./Sq.Ft. Grate Area per Hour.	Efficiency.
			%
High-temperature coke	0·79	1·77	68
Low-temperature coke	4·8	1·72	61
Semi-anthracite Scotch coal . .	3·73	1·61	53

As will be seen, the high-temperature coke with a low volatile content for equal rates of combustion has very much higher efficiency. The probable explanation is that at low rates of combustion the carbon dioxide formed by the primary combustion with the air admitted through the grate is unaffected by the comparatively inactive high-temperature coke, particularly with very low fuel bed temperatures, but the higher volatile and more active cokes readily reduce carbon dioxide to carbon monoxide,

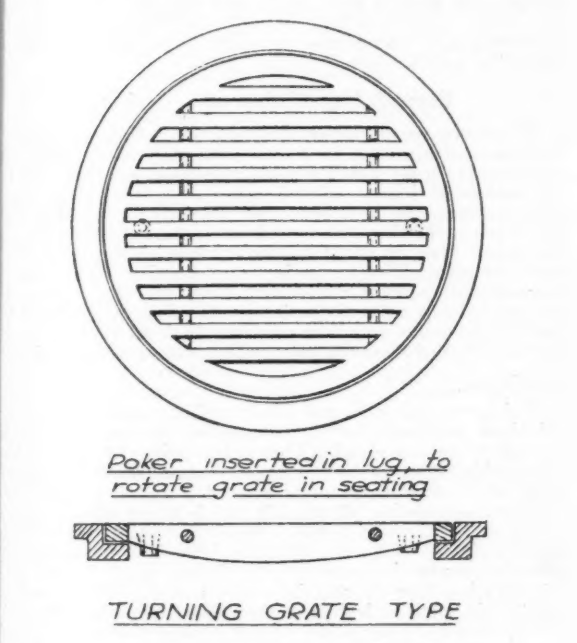

Fig. 3.—Types of grate in use to facilitate the removal of ash and clinker from the domestic coke boiler.

which to a large extent escapes up the chimney, in consequence approximately 5/7ths of the heat content of the coke is lost for every 1 lb. of coke converted to carbon monoxide, so that a relatively small amount of carbon monoxide will have a large effect on the efficiency.

Moisture in Coke.—Less than 1% of moisture in the coke makes it too dusty for convenient use. With more than 5% or 6% the effect is to reduce the flexibility and reduce the ignitability of the fuel, and over 10% of this moisture is so obvious as to cause complaints from the consumer. However, the same reasoning that shows the efficiency to be increased by a reduction of the volatile content must indicate that moisture within limits does tend to increase the efficiency of the boiler, other factors being the same.

There has been an erroneous idea that moisture improves the combustion of the fuel, but this no doubt is founded on the fallacy that the water gas reaction takes place and assists the gasification of the coke.

Reactivity.—Reactivity is a term in which there is a certain amount of confusion as to its definition, as coke which may be reactive to air, and readily combust, may be relatively much less reactive to the carbon dioxide in the fuel bed. The reactivity depends largely on the volatile matter and on the structure of the coke. Recently improvements in the structure of the coke have been made by:

(*a*) Adjustments of carbonizing conditions.

(*b*) By careful blending of the fuel before carbonizing, either with other coals or with coke breeze.

(*c*) By quenching; the structure of the coke, and more particularly the structure of the skin to a depth of about $\frac{1}{8}$ in., is of great importance in determining reactivity.

Bulk Density.—The lighter the fuel, in general, the more reactive, owing to the more open structure of the coke.

Flexibility is usually higher with a lighter fuel and the boiler is usually more easily controllable. The necessity for refuelling, however, is increased with the lowering of the bulk density; the storage space required and the size of the scuttle are also increased.

It is, of course, obvious that the lower the ash content, and higher the calorific fuel, the more satisfactory the fuel, and the more economical in usage.

The Domestic Coke Boiler and the General Public.

While the usual domestic installation, whether for hot water or for the supply of a few radiators in a small house, and the possibility of the combination of the coke boiler with the gas heaters, will be considered in a subsequent contribution, there are a number of points which though obvious to the heating engineer, builder, and coke supplier, need to be very carefully explained to the consumer himself and so might very well form a subject for a printed card or leaflet distributed to every user of the fuel.

Draught.—It should be pointed out that small leaks and cracks in the flue pipe can be stopped with special fire cement. Any check damper built in the flue away from the boiler should only be opened if made necessary by an over strong or a fluctuating draught. Any damage to the mica front of the boiler should also be rectified immediately, or the air will be drawn over the fire instead of through it.

Clinker formation emphasizes the importance of the early and regular removal of the ashes and clinkers, and that clinker can be almost entirely avoided if a steady fire is maintained rather than a fluctuating one.

The consumer should be warned not to choke the fire up with rubbish, and that all kitchen refuse for destruction should be placed on a bright fire, and the fire thoroughly cleaned afterwards.

Keeping the Fire in Over-night.—The boiler may be maintained throughout the night by careful regulation of dampers. The best position of the dampers must be determined by experiment.

It is worth emphasizing the convenience value of the gas poker, and naturally the benefit of using the right grade of fuel as well as the benefit of coke fuel rather than bituminous coal with its soot deposits and lower efficiency. The advantage in price and in guarantee of supply in purchasing coke by contract can be emphasized, and finally that the gas companies are always ready to help and advise in all problems affecting the operation of the hot water boiler.

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Rubber Gaskets for Pipe Joints and Clamps

by K. R. KNAPP

The purpose of this Paper read by Mr. K. R. Knapp, Chief Engineer, A.G.A. Testing Laboratory, Cleveland, Ohio, at the Twelfth Annual Distribution Conference at Cleveland, was to discuss some of the main factors affecting the design and selection of rubber gaskets for pipe-line use.

Returns on the recent questionnaire sent out to gas distribution engineers indicated an almost universal desire for more information about rubber compounded gaskets for mechanical pipe joints and clamps, commonly referred to as rubber gaskets or simply "rubbers." While it is generally known that gasketed pipe joints of certain types have behind them long records of successful performance there is always the question, "Can similar results be obtained with all present-day joints and gaskets?"

What can be expected of rubber gaskets? Of what are they made? How long will they last? Is there a reliable and practical means of predicting their performance ability over long periods of service? Are there significant differences between gaskets compounded from different ingredients? These are typical questions familiar to every gas engineer who at one time or another has used rubber gasketed joints for new pipe line construction or gasketed repair devices for reconditioning and maintenance work. Experience has already proved that different gasket compounds will give different results in service, yet on what basis can a gasket be judged?

Pipe lines are built to give many years of uninterrupted service. Pipe joints therefore must have a life equal to that of the pipe if long and dependable service of the pipe line itself is to be obtained. In most rubber gasketed joints all parts except the jointing material can be made of the same material as the pipe. The importance of the gaskets is therefore apparent and gives rise to the question of the life of the rubber compound from which they are made. In the face of conflicting statements, which are often made regarding a particular type of gasket or its method of application, it is evident that reliable information must be at hand to evaluate such claims properly, or misunderstandings will be the natural result.

In this Paper an attempt will be made to discuss various phases of this general subject in the hope that some of the data here given will serve as a guide to future investigations and will also help create a better understanding of rubber gaskets among those who are entrusted with the responsibility of selecting dependable pipe joints. It is also felt that such a review will be of assistance in clarifying the much discussed subject of the anticipated life of rubber gaskets in joints and clamps.

Classification of Joints.

To clarify the discussion that follows, pipe joints for gas lines may be divided into two general classes—namely, those that are rigid (or inflexible) and those that are flexible.

Rigid joints include such connections as do not allow for movement in the joint without either setting up a stress in the pipe or breaking the bond between the pipe and the jointing material. Examples of this type are the plumbers' wiped joint, soldered or sweat joints, welded joints, threaded joints, and bell and spigot joints made with lead, cement, or other inflexible or non-resilient materials.

Flexible joints are those that allow lateral and horizontal movements of the pipe in the joint without either breaking the bond between the jointing material and pipe or harming the jointing material.

It is sometimes erroneously believed that compounding ingredients are used to lessen manufacturing costs, acting as a cheaper substitute for the expensive raw rubber. A pipe joint gasket made of pure raw rubber for example would be highly unsatisfactory, as compounding ingredients and vulcanizing are absolutely necessary to give a gasket suitable physical properties. Each ingredient has its particular function well known to the rubber chemist. In a typical rubber compound, used for the manufacture of hose, nine ingredients are employed. Each serves a specific purpose and is needed to give the desired properties. Five of these are more costly than crude rubber.

Extending this thought further, we find that through this same art of compounding, rubber can be given special properties for other special purposes. As examples there may be mentioned high elasticity, as in rubber bands; extreme hardness, as in combs; resistance to abrasion, as in tyres, to temperature as in hot water bottles, to acids as in rubber-lined tank cars. These are given as indicative of what can be done with the product forming the basis of gaskets for flexible pipe joints and clamps. The qualities needed in a gasket can be obtained by scientific compounding in the same way as other rubber products can be made for specific uses.

Essential Qualities of a Gasket.

There are so many variable factors affecting the performance of a gasket in a pipe joint that it is inadvisable to attempt to set down general specifications applicable to all makes of joints and all types of service. The same gasket compound that performs perfectly in one joint may not be as effective when used in another. Then, too, in the same type of joint, different kinds of service in most cases require different gasket compounds. Manufactured gas service requires a different compound from one used successfully in natural gas lines. Bearing this in mind let us look for some common qualities that all gaskets should have. These follow together with a discussion of each.

Resilience.

Rubber compounds are ideal packing mediums because of their resilience or their capacity to store up elastic energy when deformed. This is the property that enables the rubber gasket to maintain permanently a pressure against its confining surfaces and keep the joint tight. Rubber is capable of storing much more elastic energy than are other substances. Steel, for instance, which is highly elastic, can only store a relatively small amount of elastic energy because at its elastic limit it has only stretched a few thousandths of an inch. Other packing materials, such as lead, asbestos, fibre, &c.. can store little or no elastic energy—they do not possess this very essential quality of resilience. While all rubber compounds are more resilient than other packing materials, the degree of resilience varies greatly with different compounds. A gasket compound should have high resilience.

Compression-Set.

Compression-set is another characteristic of rubber, closely allied to resilience. It may be defined as a measure of the ability of the rubber under compressive stress to return to its original size and shape after the stress is removed. The compression-set tests described in detail elsewhere in this Paper enable the investigator to predict the cold flow characteristics of a gasket in service. It is believed that a good gasket compound should have as low a compression-set as is possible without the sacrifice of other essential qualities.

Resistance to Age.

Generally speaking, the favourable environment in which rubber gaskets function helps to preserve them from deterioration as will be explained later. However, the age-resisting qualities of rubber compounds differ widely even under conditions favourable to long life. By a careful selection of compounding ingredients and the addition of anti-oxidants it is possible to produce a gasket compound that is far superior in age-resisting qualities to the old compounds that have performed so well in the past. This, then, is another essential quality of a gasket—it should age well in storage and in service.

Packing Ability.

Since the purpose of all pipe joint gaskets is to pack off the line pressure, the gasket compound should have good packing qualities. That there is a great difference between the packing qualities of different gasket compounds is evident from the fact that, in certain quick packing tests

made in the past, one compound made a tight joint up to 1,000 lb. per sq.in. gas pressure while another compound in the same joint leaked gas at less than half that pressure. The only reliable method of determining the packing qualities of a particular type of gasket is to assemble the gaskets in joints for which they are designed and test them under gas pressure until leakage occurs.

It is generally believed that the hardness of a gasket has a decided influence on its packing qualities. Within certain limits some tests indicate that the softer gaskets have better packing qualities. On the other hand, tests have been made showing exactly the reverse—that is, the hard compound packs better than the softer ones. Therefore, great care must be used in claiming any definite relationship between hardness and packing qualities, which must be balanced with the known fact that the hard compounds generally have better aging qualities and show greater resistance to the deteriorating action of gas condensates than do the softer compounds.

A study of a great many packing tests reveals the fact that sulphur bloom materially detracts from the packing qualities of a gasket. This fact was also demonstrated by the recent tests conducted by the A.G.A. Laboratory for the Cast Iron Pipe Research Association and the S. R. Dresser Manufacturing Co. In the past, practically all compounds with superior age-resisting qualities contained an excess of sulphur (the excess sulphur making up the sulphur bloom). However, since the introduction of anti-oxidants, non-blooming compounds have been made with age-resisting qualities far superior to the age-resisting qualities of the old type blooming compounds. Hence the sulphur bloom is no longer a necessary evil. It can be concluded, therefore, that a gasket compound should be non-blooming.

Resistance to Condensates.

Obviously, a gasket should be compounded to resist the substances with which it will come in contact in service. To do this it is necessary even for the experienced compounder to try a great many combinations of compounding ingredients, testing the results of his experiments as they progress. Laboratory tests, correctly interpreted, provide some valuable information concerning the effectiveness of the different compounds, but the final test should be made in the pipe joint under conditions as close to actual service conditions as possible.

The problem of developing a suitable gasket compound would be very simple if it were only necessary to provide a compound with one or two definite characteristics—for example, a compound with a Durometer hardness of 75 and a tensile strength of 2,000 lb. per sq.in. But the problem becomes quite complex, though not impossible of solution, when detailed specifications have to be met with respect to compression-set, aging in storage, aging in service, packing qualities, and resistance to gas condensates. In a great many cases it has been found that improvement of one certain quality in a compound has meant the impairment of other important desirable properties to the point where the gain in one direction was more than offset by the loss in another. The solution, of course, in such cases is to approach the problem from an entirely different compounding angle or to work for a balance that will provide all the desirable properties to a satisfactory degree.

Four Methods for Studying Pipe Joint Gaskets.

The study of pipe joint gaskets may be conveniently approached from four different angles, as follows:

I. Inspection of old gaskets.
II. Conduct of accelerated tests.
III. Determination of physical properties.
IV. Measurement by special instrument.

These four methods of study are discussed in greater detail below.

Inspection of Old Gaskets.

Many available records attest to the fact that properly compounded gaskets can be depended upon to last as long as the pipe and joints in which they are used. The earliest known use of rubber as a pipe jointing material was in England in 1863; other early installations were in France (1870) and in the United States (1870). From time to time articles have been published on this subject, all of them giving evidence in favour of rubber gaskets.

In the cases where failures have occurred, investigation has always shown that they were due in part to some unusual joint or service condition. Most of the old gaskets were quite soft as compared to the majority of gaskets used to-day, and the clearances, where parts of the gaskets were unconfined, were usually much greater than is permitted in present-day joints. This condition, in some cases, led to excessive flow of the gaskets. Other instances have been encountered where the service conditions have been unusually severe and the gasket used was not specifically compounded to resist the action of the line contents. That gaskets failed under these conditions is not surprising. On the other hand, with the many advances made in the art of rubber compounding and the improvements in the manufacture of both pipe and pipe joints, there is every reason to believe that a gasket developed for a particular service in a modern pipe joint can be expected to function perfectly during the entire life of the installation.

Conduct of Acclerated Tests.

Several years ago engineers in the course of considerable development work on gaskets came to the conclusion that when new gasket compounds were developed, regardless of their effectiveness as indicated by laboratory tests, the final measure of their value should be based upon results obtained from actual pipe line test installations. This plan included testing the gaskets in the joints for which they were designed under conditions as close to actual service conditions as possible. Consideration was also given to methods of accelerating the tests.

A continuous gasket testing programme was immediately started and is still in process. Hundreds of gasket compounds have been tested under various conditions, the tested gaskets being carefully examined and graded with respect to deterioration at exposed surfaces, variations in hardness, cold flow, swelling, &c. Where the gaskets are tested for manufactured gas service, the test line is completely filled with the drip oil from a manufactured gas system and maintained under high pressures. In the case of gaskets for natural gas lines, the test line is filled with drip gasoline or casing head gasoline. Lines filled with different types of crude oil and other fluids are also included in the testing programme.

When this testing programme was first started, it was supposed that the tests could be accelerated by increasing the line pressures. However, the test results did not substantiate this supposition which at first seemed perfectly obvious. In other words, instead of the line pressure driving the fluid into the gaskets, it apparently helped confine the gaskets still more and prevented the fluid from being absorbed. This theory was later verified in a high-pressure crude oil line through which various grades of Texas crude oil were pumped at pressures up to 1,100 lb. per sq. in. The joints under observation were installed close to a pumping station where they could " feel " the pulsations of the pumps. After being in service eighteen months two of the joints were dismantled and the gaskets, which were specially compounded for crude oil and gasoline, were found to be in perfect condition.

These pipe line tests have shown conclusively that for any given service there is a surprising difference in performance between various compounds.

Tests have also shown that the rate of deterioration of the gaskets decreases with time. In order to get results that are clear cut enough to permit a definite grading or rating of the gaskets under consideration, it was found necessary to continue the test for a minimum period of about four months. After this, continuance of the test was valuable mostly for confirmation of the results and to give greater significance to them. Some of the test lines in question have now been under pressure for more than five years.

Determination of Physical Properties.

All structural materials, including rubber compounds, have certain physical properties which may be used as a guide in selecting the proper material for a particular application. Some of the physical properties of rubber are not as well defined as the corresponding properties of most other materials, and a certain amount of judgment based upon experience must, therefore, enter into the selection of rubber compounds for a specific purpose. For example, mild steel has a definite elastic limit, and so long as it is not stressed beyond this limit it will always return to its original dimensions when the stress is relieved, that is, it will not take a permanent set unless stressed beyond the elastic limit. Rubber, on the other hand, has no such definite elastic limit and may be stressed almost to the breaking point without permanent set, provided the load is released immediately. If, however, the load is maintained, for a period of time, the rubber will show a temporary set, but after the load is released the set will be gradually reduced. Thus time becomes an important factor in measuring certain physical properties of rubber.

Rubber under compression is often said to behave like

a liquid, but this concept of the nature of rubber is not entirely correct. A liquid is distinguished from a solid by the absence of permanent resistance to forces tending to produce a change of shape, and rubber certainly cannot be placed in this category. Another erroneous concept is that rubber is compressible in the sense that its volume can be reduced appreciably under pressure. Rubber, in respect to compressibility, may be included with other solids that are compressible only to a very small degree and which for all practical purposes are considered incompressible.

The principal physical properties to be considered in evaluating the quality of rubber compounds are the following:

(*a*) Specific gravity.
(*b*) Hardness.
(*c*) Tensile strength.
(*d*) Elongation.
(*e*) Resilience.
(*f*) Permanent set.
(*g*) Cold flow.

Unfortunately, there are no generally accepted methods of determining all of these properties for rubber and in many instances it is necessary to devise special tests simulating service conditions. The following detailed discussion of the various physical properties will be confined to gasket compounds and should not be considered as applicable to all rubber compounds.

(*a*) The specific gravity of rubber is the ratio of the mass of the rubber to the mass of an equal volume of water, and it can be readily determined with a gravity balance. Some years ago it was believed that a rubber compound to be suitable as a gasket material must have a certain minimum specific gravity, but later investigations have not substantiated this belief. There is apparently no definite correlation between specific gravity and the performance ability of a gasket compound, although the best resisters of pipe line condensates known to-day are a class of extremely heavy materials compounded with lead oxide. The effect of the lead oxide may be purely chemical and it does not necessarily follow that every high gravity compound, or every compound containing lead oxide, is a good resister of drip oil. Specific gravity determinations are not of so much value in selecting a gasket compound as in maintaining uniformity after the selection has been made.

(*b*) There are a number of instruments available for measuring the hardness of rubber, the principal ones being the Durometer, Plastometer, Densimeter, and the A.S.T.M. Hardness Tester. All of these instruments measure the depth to which a needle or plunger of certain dimensions penetrates the rubber under a given load. The most accurate testers employ a dead load to depress the penetrating element, but in the Durometer—which is the best known and most convenient to use—the load is applied by a spring of sufficient accuracy for all practical purposes.

The hardness of rubber compounds most commonly used for gaskets ranges from 60 to 80 Durometer. The softer grades are used largely for specific applications requiring a high degree of deformability, but for most purposes experience has shown that a hardness of 70 to 75 will give the best service. In general, the softer stocks have less resistance to pipe line condensates and show a greater tendency to extrude through the clearances prevailing in all pipe joints. There is no direct correlation between hardness and packing qualities, as is commonly supposed. As mentioned before, it has been found by tests that some of the relatively hard compounds pack better than some of the softer stocks.

Hardness tests are of considerable value in checking the uniformity of an established compound because they reveal the effect of over-cure, the usual tolerance allowed being *plus* or *minus* three points from the specified hardness. Durometer tests are also useful in determining the effects of ageing.

(*c*) For some uses of rubber the tensile strength is of utmost importance, but it is of relatively little value in comparing gasket compounds because all gaskets are used in compression. The tensile strength of a rubber compound, of course, can be very definitely determined by pulling a specimen of prescribed dimensions until rupture occurs. An attempt was made in a recent investigation to correlate this property with drip oil resistance. While the results of this investigation were not conclusive, they indicated that all other factors being equal, the compound with the highest tensile strength should be chosen. This property also serves as a useful " control " in maintaining gaskets to certain specifications.

(*d*) In the routine physical tests of rubber compounds the elongation is usually measured during the tensile test, but it has no special significance in the selection of gasket compounds.

(*e*) The term " resilience " is often improperly used in discussing the qualities of rubber and rubber compounds. According to the correct definition, resilience is the potential elastic energy stored up in a deformed body. The modulus of resilience, or unit resilience, is the elastic energy stored up in a unit volume at the elastic limit. Unfortunately, the true modulus of rubber cannot be determined because rubber does not have a definite elastic limit, but it is possible to compare the resilience of rubber compounds by measuring this property at some arbitrary stress or deflection. A comparison of the resilience of different compounds should be of considerable value in the selection of gasket material, because it is the measure of the energy available to maintain a packing pressure, but up to this time it has received little consideration.

(*f*) The terms " permanent set " and " cold flow " are frequently confused and should be clearly understood. Cold flow is the process of readjustment of the particles of a material under stress, whereas permanent set is the deformation resulting from cold flow, measured after the stress is relieved. In the case of rubber, the permanent set measured in a test is usually a sub-permanent set because the rubber continues to recover from its deformation for a long time after the load is removed.

Permanent set can be measured either under tension or compression, but for comparing gasket compounds, compression tests are preferred because gaskets in pipe joints are under compression. Such tests are specifically referred to as compression-set tests and may be made under either constant deflection or constant pressure conditions.

Constant deflection tests are made by simply compressing a sample of rubber of specified dimensions to a certain percentage of its original thickness for a specified period of time, and then measuring the thickness of the sample after the load has been removed for a certain period of time. Constant pressure tests are made in the same manner except that a constant unit pressure is maintained on the sample by means of a calibrated spring. In either test the compression-set is the difference between the original and the final thickness divided by the original thickness, and is expressed as a percentage.

(*g*) A compression-set test measures the amount of cold flow occurring during the test and also indicates the amount that can be expected in service. In pipe joints, cold flow results in extrusion of the gasket material through the prevailing clearances, and it has been suggested that this tendency be measured directly rather than obtain it by inference from the compression-set tests. The proposed test would involve compressing a sample of rubber with a plunger within a cylinder to a given unit pressure and measuring at regular intervals the extension of the rubber through a standardized orifice in the plunger.

Measurement by Special Instrument.

The one basic physical requirement of gasket materials is that they maintain an adequate packing pressure at all times. Only a few of the physical tests that have been described thus far give any indication of how well a rubber compound under compression will maintain packing pressure, and none of them measures this characteristic directly.

The Sealometer, developed by Dresser Laboratories, primarily for determining gasket pressures in a pipe joint, has made possible a new kind of test particularly adaptable for comparing gasket compounds. In this test a sample of the compound $\frac{3}{4}$ in. in diameter by $\frac{1}{4}$ in. thick is compressed between two platens until an initial unit pressure of 1,000 lb. per sq.in. is developed against the platens. The platens are then fixed in this position and readings of the unit pressure exerted by the sample against the platens are taken at regular intervals with the Sealometer. When the pressure readings are plotted against time, a characteristic curve for the compound under test is obtained.

It should be noted that the loading conditions of this test closely simulate actual service conditions. When a pipe joint is made up, a certain initial pressure is applied to the gaskets, and no external mechanical follow-up is provided to maintain the pressure other than that supplied by the elastic deformation of the metal parts comprising the joint. Exactly this condition prevails in the tests with the Sealometer, whereas in compression-set tests a constant load is maintained on the specimen throughout the test. Also, observations may be made at any interval of time without disturbing the conditions of test, and the test may be continued as long as desired.

The physical characteristics of a gasket compound are not the only factors that determine how well the gasket pressure will be maintained in a pipe joint. The design of the joint itself is an equally important factor, and for this reason Sealometer tests on gaskets installed in the joints for which they were designed are believed to be among the most significant kind of tests that can be made.

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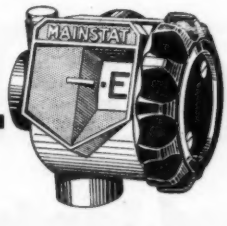

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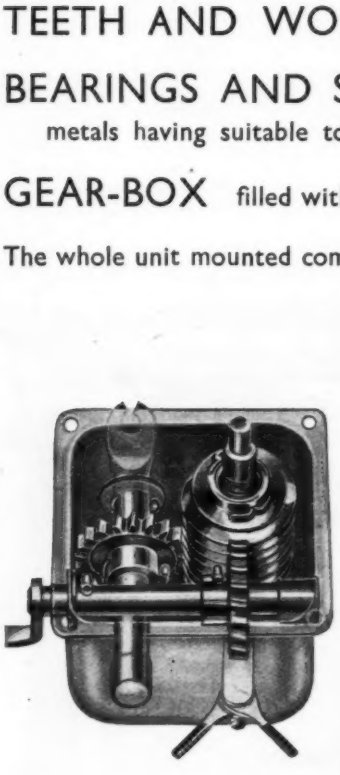

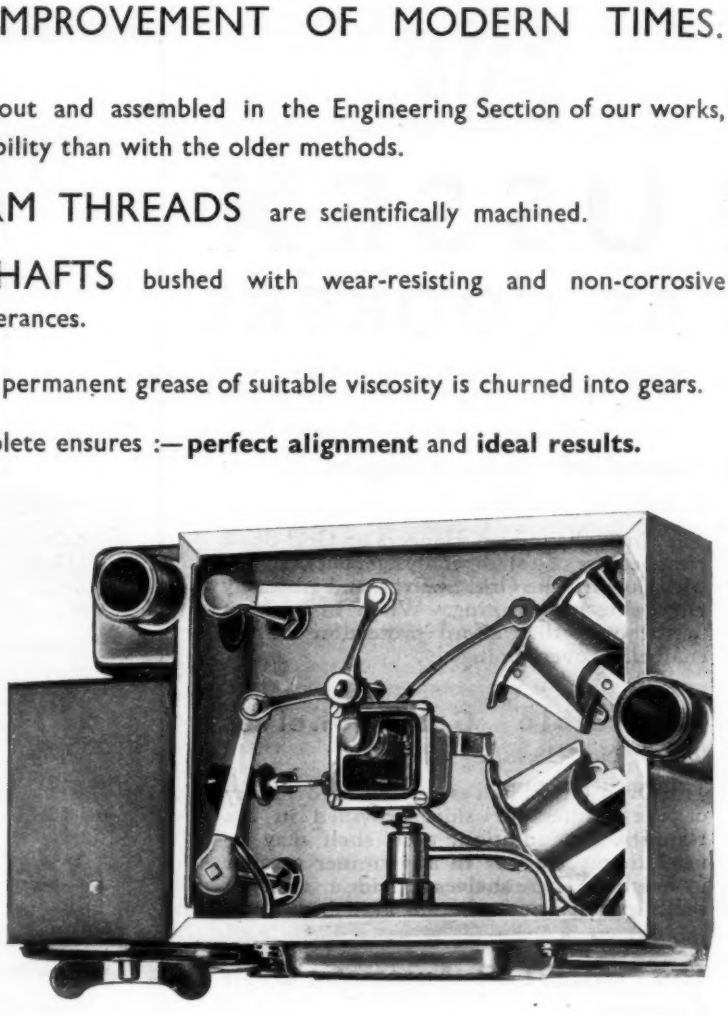

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Factors Affecting Gasket Life.

Heat, Light, and Oxygen.

When the layman thinks of rubber he usually thinks of the rubber bands he has placed around some papers in his desk, of his rubber boots or raincoat, or of the tyres on his automobile. These rubber articles deteriorate with age. Because of this fact, some doubt may naturally arise concerning the long life of rubber gaskets in pipe joints. A better understanding of the factors and conditions which cause rubber articles to deteriorate will help clarify this apparently paradoxical situation.

Like most substances, rubber is subject to the effects of heat, light, and oxygen. Most rubber compounds are cured or vulcanized at a temperature of approximately 300° F. The time of curing is accurately predetermined and as soon as the desired physical properties are obtained, the application of heat is discontinued. If the finished rubber articles are subjected to excessive heat in service or in storage, the curing or vulcanization continues and the rubber either becomes hard and brittle or soft and sticky, depending upon the nature of the compound. If the rubber is kept for an extended period of time in a warm place, vulcanization slowly continues even though the temperature is considerably lower than 300° F. Obviously, rubber articles should be stored and used in a cool place.

It is a well-known fact among rubber chemists that direct or diffused sunlight has a pronounced deteriorating effect on vulcanized rubber. Rubber exposed to sunlight develops surface cracks, becomes hard and brittle, and loses its resilience. Sunlight is, to a very great extent, responsible for the surface cracks in automobile tyres.

The tendency of rubber compounds to deteriorate when subjected to the influence of atmospheric oxygen has been recognized for many years. This deterioration is the result of a combination of oxygen with the rubber hydrocarbons. Research work has revealed the fact that certain substances when added in very small amounts inhibit or retard this oxidation. These inhibitors, referred to before and known as anti-oxidants, are a very important development in the art of rubber compounding because they greatly prolong the useful life of rubber products where deterioration due to oxidation is a factor.

Once the effect of heat, light, and oxygen is understood, it is easy to see why rubber bands lose their resilience, why rubber boots and raincoats become hard and useless, and why the spare tyres on automobiles develop surface cracks and deteriorate. Conversely, it is readily understandable that correctly compounded pipe joint gaskets should last indefinitely because:

(*a*) In most cases the pipe lines are buried and consequently the gaskets are not subjected to high temperatures.

(*b*) Little or no light can reach the gaskets, even if the line is not buried, because they are almost completely confined in the joints.

(*c*) The gaskets are also protected from atmospheric oxygen because of this same almost complete confinement.

In view of these conditions under which pipe joints function, it is not surprising that after twenty-five to thirty years of service these gaskets are found to be as resilient and " alive " as new gaskets.

Gas Condensates and Other Solvents.

Certain fluids such as benzole, naphtha, gasoline, and carbon tetrachloride are known as solvents of rubber. Since the drip or condensate from manufactured gas and from natural gas contains appreciable amounts of benzole and naphtha these gas condensates are generally considered as rubber solvents. It is not generally understood, however, that these fluids are actual solvents of uncured rubber only, they are not solvents of vulcanized rubber.

Crude or raw rubber will actually dissolve in these solvents. Such solutions are known as rubber cements and adhesives. When the solvent evaporates, the rubber can be recovered in the same manner as salt can be recovered from a salt water solution.

If a piece of ordinary vulcanized rubber is immersed in a beaker of manufactured gas drip, the rubber in the compound will not dissolve. It will, however, absorb the solvent, swelling or increasing in volume a corresponding amount. As the swelling increases, the bond between the rubber and the various compounding ingredients may be broken down until finally the compound will be completely disintegrated. In addition to the absorption, a chemical change known as depolymerization also takes place. Briefly, depolymerization may be considered as a partial breaking down of the rubber molecule without actually changing the chemical composition but with some change in physical properties.

It is possible to compound rubber so that the disintegration and depolymerization due to the absorption of solvents is reduced to a minimum. Such a compound may absorb the solvent and swell as much as an ordinary compound, but when it is removed from the beaker and the solvent is allowed to evaporate, the sample soon assumes its original size and shape with very little change in physical properties.

It must not be construed from the above that the plain immersion test alone can be considered as a final measure of the effectiveness of a gasket for pipe joint application. It serves only as an accelerated method of obtaining relative information concerning the resistance of different compounds to solvents. The results must be carefully interpreted and correlated with other tests which more closely simulate service conditions.

In some cases it has been found that the fluid in a pipe line, such as an acid, while not detrimental to rubber, does attack one or more of the other compounding ingredients. Where such special types of service are involved, it is always advisable to investigate the solubility of all the ingredients used in the gasket compound.

Proper Installation.

Reports of leaking joints attributed to gasket failures have often been traced to scale or dirt beneath the gasket, defective pipe surfaces, uneven application of gasket pressure, and other causes that might have easily been prevented if the joints had been properly and carefully assembled. Cases have been encountered where the gaskets were actually put on backwards. Under such conditions neither gaskets nor joints can be expected to give satisfactory service. The importance of careful installation cannot be overemphasized.

Conclusion.

The purpose of this Paper has been to discuss briefly some of the main factors which enter into the proper design and selection of rubber gaskets for pipe line use. It will be obvious, of course, that many other details must be kept in mind in making a proper selection for any particular service condition. It is obvious also that without a complete knowledge of the conditions under which the joint must perform in service and the properties of the gasket itself, no definite selection may be made. Much the same situation applies here in selecting the proper grade of pipe material for the conditions under which it is intended to perform in service. It is well recognized that one set of conditions which may not affect one material may affect another. In exactly the same way, this statement is true of the gasket itself. Accordingly, selection of a particular gasket should only be made after a thorough study of the conditions which it is intended to withstand, and after its effectiveness has been proved by service tests in the joint in which it is to be used.

The user of pipe joints naturally cannot be expected to make a detailed study of gasket materials. He is, however, able to analyze carefully the conditions under which any particular pipe line should perform and make them available to reliable manufacturers of joints. The manufacturer can then select the proper gaskets for the conditions in question. Such a manufacturer is in good position to provide in any gaskets which he may furnish the various desirable characteristics whether or not they may be specified by the purchaser, for the reason that, due to detailed investigations, he is qualified to make the proper recommendations. It should be recognized that the responsibility of the user does not cease after the selection of the proper joint and gasket. He should take precautions in all cases to be sure the proper installation is made as the advantage gained by the use of the best grade of material may be entirely nullified by faulty installation.

The question " How long will a gasket last? " may, it is believed, be answered by saying that when properly selected and installed it should have a period of service comparing favourably to that of other parts of the line in which it is installed. In many cases such a gasket will be found in serviceable condition after failures have taken place in other parts of the line. This statement is considered justified in view not only of the generally satisfactory performance records of rubber gaskets in the past but because of the marked superiority of gaskets of the present-day design over those of former types. The results of extended field tests may be considered as verifying this statement.

Grateful acknowledgment is made of the assistance given by the S. R. Dresser Manufacturing Company in the collection and assembly of the material covered by this presentation.

French Gas Industry

Review of the 58th Congress of the Union Syndicale de l'Industrie Technique du Gaz en France

(*Continued from p.* 314.)

Coke Screening.

G. Rouveix gave an account of the various types of screens available for the grading of coke and discussed screening principles. The effect of alteration in the size distribution of the feed, the effect of internal and surface moisture, the effect of density and the effect of the slope of the screen were among the factors discussed, as were also the relative merits of square and round apertures. The latter are preferred as wear is more regular, though square apertures give a more uniform product in their early life.

It is desirable that the first stage of screening should eliminate sizes larger than 1¾ in. This should be effected under " brutal " conditions, for example, by allowing the coke to fall on to bar screens or grizzleys so that any fissured pieces may break. When cutting is necessary, two stages are recommended if the maximum size of the coke exceeds 6 in. Grades smaller than 1¾ in. in size should be screened out from the first stage product before the coke passes to the second stage. Suitable cutting machines consist of two rolls, one stationary and one mobile. The rolls are of cast-iron and carry cast-steel rings. The cutting machine should be capable of being by-passed.

Screening of the smaller sizes may be effected in one operation or two depending on the type of screens employed. With oscillating screens, four sizes of smalls can be obtained directly with a good screening efficiency.

In the case of vibrating deck screens, two screens in tandem are desirable. The first one, which carries two meshes, and which makes 1¾ by 1⅜ in. and 1⅜ by 1 in. coke nuts, should vibrate with a large amplitude and low frequency, while the screen which separates the 1 by ½ in. nuts from the breeze should have a small amplitude and a high frequency. Conditions should be so arranged that a floating charge of coke is obtained on the screens, the pieces being given a trajectory so that they tend to pass normally through the apertures.

The grades should be rescreened once or more so that the maximum yield of each is obtained and all dust is eliminated.

Coke-screening plant should be liberally designed. As a minimum requirement, the plant should be capable of screening the whole day's make of coke in 8 hours. There should, however, be sufficient reserve capacity to enable unscreened stock coke to be handled in addition, when necessary, during the same period.

One of the essentials of a good screening system is the provision of a regular feed.

A Novel Method for the Treatment of Devil Gases.

L. Sabrou described an extensive investigation carried out at the Ivry works of the Paris Gas Company with the object of providing a satisfactory means of rendering innocuous the gases from an ammonia saturator.

After many types of treatment had been tried, the simple solution of scrubbing the gases with ammonia-still effluent was hit upon. The effluent contains lime since fixed ammonia is recovered.

The gases contain, on an average, 77% of water vapour, 12% of CO_2, 10% of air and 1% of sulphuretted hydrogen, ammonium sulphide and cyanogen with traces of arsenic, pyridine and tar acids. The cycle of the saturator is about 5 hours.

After small scale tests at Ivry, a full-sized plant was erected at Clichy. The plant consists of an effluent-sealed section of a bubble-cap fractionating tower surmounted by three cylindrical sections filled with Raschig rings resting on grids. The devil gas is sucked through the apparatus by means of a fan and effluent liquor is supplied by means of a pump in counter-current to the gas. The spent effluent liquor is pumped from the seal, diluted with other waste water, and discharged from the works. The apparatus has been in use for a year and satisfactorily treats two-thirds of the noxious gases produced at Clichy, 1,320 gallons of ammonia-still effluent being supplied per hour. If the size had been a little larger all the gases could have been treated. The gas, after treatment, gives no reaction with lead acetate paper. The reactions involved are somewhat obscure, but it appears that all the sulphuretted hydrogen becomes oxidized to sulphate since the increase in the total sulphur and in the sulphate content of the effluent liquor is very nearly equal to the sulphur equivalent of the gases treated. Possibly, phenol and other components of the liquor act as oxygen carriers and assist in the oxidation of the sulphuretted hydrogen.

Sludge deposited in the plant is removed once weekly by opening the manholes and flushing out each section with a powerful stream of water. This presents no difficulty if precautions are taken against the sludge becoming dry.

The process serves two ends since, not only are the devil gases purified and rendered fit for discharge to atmosphere but the effluent liquor itself becomes partially purified as the cyanides and a portion of the phenol are eliminated.

The process, which is covered by patents in France and other countries, represents a great improvement on the old system of passing the gases into a coke fire.

Automatic Control in a Compressor Station.

M. Séranne described the automatic compressor station which supplies gas to feeder mains in the Toulon district. Gas from the Toulon Works is supplied by La Seyne, Ollioules, Sanary, and Bandol, there being holders at La Seyne and Bandol. Four low-pressure governors are present in the system.

The distribution system has been so arranged that labour is eliminated. Hand operation would have involved a staff of two men to work the compressors in relation to peak consumptions. At night no gas is supplied to the feeder mains.

The three rotary compressors employed are of the constant speed type and have capacities of 35,000, 35,000, and 70,000 cu.ft. of free gas per hour respectively and operate at a maximum gauge pressure of 14 lb. per sq.in. The driving motors which are respectively of 50, 50, and 110 H.P. size are supplied with forced air ventilation. They are operated by means of servo-motor relays controlled by a manometer on the high-pressure side of the compressors so that a motor starts up when the pressure in the feeder main falls to a predetermined value and stops when a predetermined pressure is reached. The gap which may be arranged between these pressures depends on the cost of power and on the maximum number of restarts per hour which the electrical equipment can suffer.

Obviously the power consumption is greater than it would be if gas were compressed strictly in synchronism with the demand and at the necessary pressure. From the load-time consumption curves of a typical day it appears that 77 units per day would theoretically be required for the compression of 320,000 cu.ft. of gas daily. With a setting of 4·2 lb. per sq.in. (minimum) and 7 lb. per sq.in. (maximum) the power consumption becomes 140 units. The extra power is thus 63 units per day or, say, 23,000 units per annum and the extra cost is £74 per annum with electricity at 0·775d. per unit (francs converted at par of exchange). Furthermore, the extra capital costs involved for automatic control represented £240, necessitating annual charges of £24. The total costs of automatic control are thus equivalent to £96 per annum in comparison with a wage cost of £240 for two men with hand operation.

The gas which enters the compressors from the Toulon holders is filtered previously. On the high pressure side of the compressors are (1) a hand operated by-pass valve by means of which connection between the inlet main and the outlet main of the compressors can be established, (2) an automatic valve which performs the same function if the pressure in the feeder mains exceeds a safe figure, (3) an oil filter to remove oil carried over with the gas, (4) a back-pressure valve which shuts when the compressor is shut down, and (5) a further back-pressure valve which puts the feeder main in direct communication with the holders if the pressure in the feeder main falls below the holder pressure due to any irregular stoppage of the compressors.

Ancillary equipment includes (1) a manometer with a servo-motor which actuates the starting up and shutting down of the compressor motors and (2) a pressure gauge in circuit with a klaxon which warns the gas-works staff if the pressure in the feeder main is either excessive or in-

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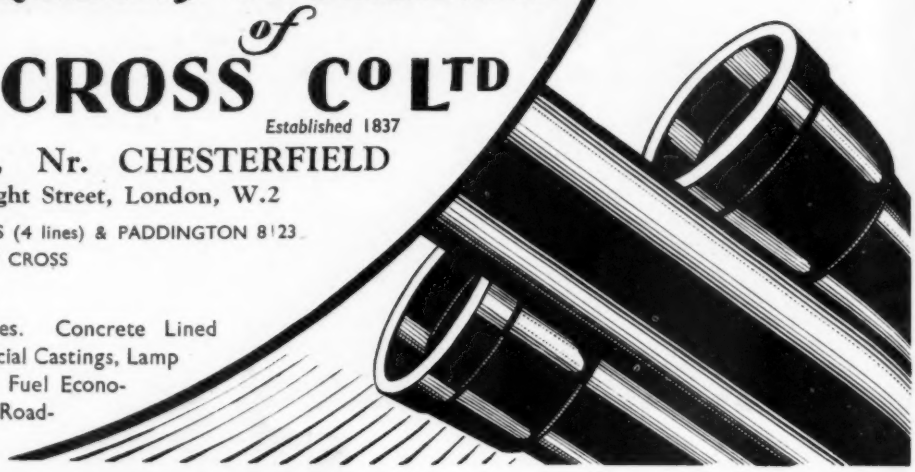

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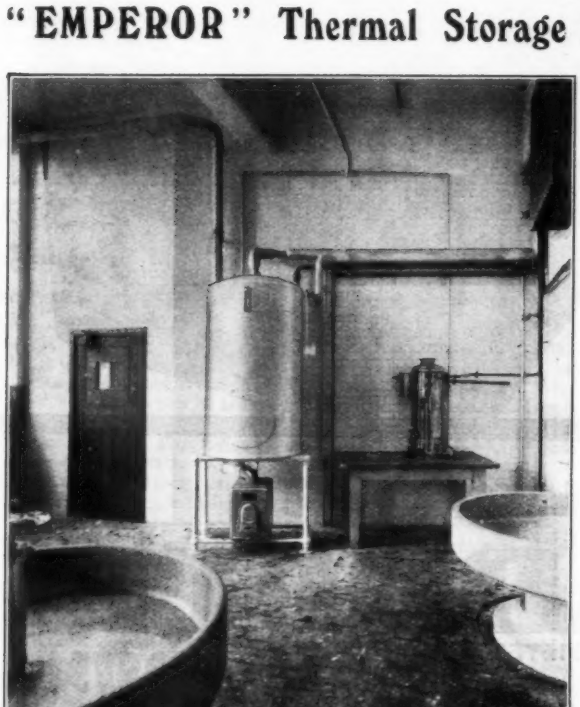

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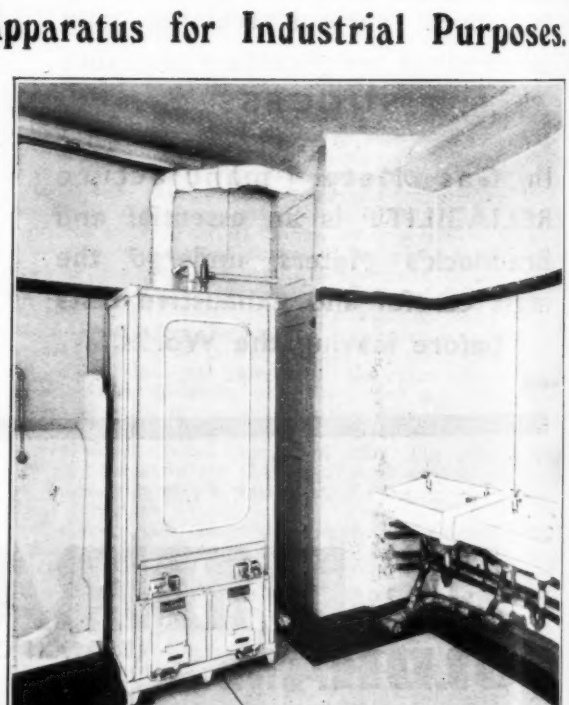

Twin-Unit Thermal Storage Apparatus supplying Ranges of Hand Basins in the Staff Lavatories. Capacity 200 gallons.

The above photographs show two out of seven Gas-fired Hot-Water Installations for the Lavatory, Culinary and Cleaners supplies at the Headquarters of the Iliffe and Cornwall Press, London, S.E. 1.

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adequate. Also, on the inlet side of the compressors is a bell chamber device which shuts off the compressors if the inlet pressure falls to a value so low that there would be danger in allowing them to continue working.

The maximum number of stoppages which the largest motor can stand is 15 per hour.

Matters are so adjusted that, when the pressure in the feeder main falls to the predetermined minimum, the valve of one of the compressors is opened by the servo-motor device. Through the intermediary of a delayed relay the starting up of the compressor motor is delayed for a few seconds and the motor starts up only if the water pressure is sufficient to provide adequate cooling of the compressors.

Visible and acoustic alarms are provided in all the control panels. They give warning of a stoppage due to any of the following causes: (1) Failure of the current, (2) inadequate inlet pressure of the gas at the compressors, (3) inadequate pressure of the cooling water of the compressors, (4) sudden increase in the power consumption due to a short circuit, or (5) failure of the automatic equipment.

(To be continued.)

Gas Undertakings' Results

Airdrie.

Mr. Archibald Kellock, Engineer and Manager of the Airdrie Corporation Gas Department, reports that for the past financial year the income of the Undertaking was £34,273, an increase of £1,031 over the previous year. The total expenditure was £26,964, against £25,911 for the previous year, an increase of £1,054. The surplus balance of £7,309 is carried to the credit of net revenue account to meet the annual charges—viz., instalments of loans repaid, £2,771, and sinking fund, £1,551. The make of gas last year was 149,201,000 cu.ft. against 144,400,000 cu.ft. for the previous year, while gas sold totalled 140,006,000 cu.ft. against 135,404,900 cu.ft. Coal carbonized was 7,895 tons against 7,775.

Atherton.

The annual report of the Atherton (Lancs.) Council Gas Department gives gross revenue at £15,604 and the gross expenditure £13,470, leaving a gross profit of £2,134, out of which interest and sinking fund charges amounting to £1,271 were met, leaving a net profit of £863.

Crieff.

The Crieff Gas Light Company, Ltd., at its 82nd annual general meeting, declared a dividend of 7½%, free of tax. The year's profit was £1,414, which, added to the balance brought forward of £1,132, made a total of £2,546.

Cupar.

At the annual general meeting of Cupar Gas Company, Ltd., held on July 29, it was reported that there was a credit balance of £2,353, while £5,880 had been spent on wages, manufacturing costs, and maintenance of plant. The sale of gas produced £8,994 and £1,279 was realized from the sale of residuals. A dividend of 10%, tax free, was declared on the ordinary shares, being 1½% more than last year.

Jersey.

That steady progress continues to be made in the use of gas in Jersey is indicated by the fact that at the recent annual meeting in St. Helier of the Jersey Gas Light Company, Ltd., Mr. Harry Morris, Managing Director, was able to report that the production during 1934 had amounted to 328 million cu.ft., an increase of nearly 20 million cu.ft. over 1933. The most striking feature of the year's operations was perhaps the results obtained by the Sales Department which showed increases over 1933 of 50% in the sales of gas cookers and 100% in geysers and boilers. Mr. Morris has furnished us with an interesting comparison of the 1934 results as compared with those of seven years ago (1927). In that year the production amounted to 245 million cu.ft., so that during that period there has been an increase of over 33%. From 7,922, the number of consumers has advanced to 10,562, of which latter 6,052 or nearly 60% are supplied through slot meters. Mains have been extended from 66 to 88 miles and, while the number of consumers per mile of main remains at 120, on the other hand the consumption per consumer increased from 29,108 to 29,299 cu.ft. The Company is maintaining its usual dividend of 7%.

Johnstone.

At a meeting of the Johnstone Town Council it was reported that the Department had had a very satisfactory year. The consumption of gas had reached the total of 149 million cu.ft., an increase of almost 2,800,000 cu.ft. compared with last year. There was a profit of over £800.

Leigh.

The net profit for the Leigh Gas Department for the year was £5,178, which was equivalent to a profit of 4¼d. per 1,000 cu.ft. The profit had been made at a selling price of 2s. 4d. per 1,000 cu.ft., or 1s. 2d. below the pre-war charge. The new industrial price of 1s. 3d. per 1,000 cu.ft. for manufacturing purposes has excited great interest.

Midhurst (Associated Gas and Water Undertakings).

The report of the Directors of the Midhurst Gas Company, Ltd., for the year ended March 31, 1935, states that the sale of gas for the year increased by 2·65%. The number of consumers rose to 657, and the sale of appliances created a record. Reduced charges for gas were introduced in the autumn. Since the close of the financial year, a supply of gas has been afforded to the village of Easebourne, and the Company's showrooms have been enlarged and modernized. Interim dividends at the rate of £2 10s.% on the original shares and £1 15s.% on the new shares (both less tax) have been paid. The Directors recommend final dividends of £2 15s.% on the original shares, less tax (making £5 5s.% for the year), and £1 18s. 6d.% on the new shares, less tax (making £3 13s. 6d.% for the year), leaving a balance of £1,851 to be carried forward.

Nelson.

The annual report on the working of the Nelson Gas Department during the year ended March 31, 1935, states that there was a gross profit of £34,050, and a net profit of £11,478. During the year 22,387 tons of coal have been carbonized; all at the Brierfield Works. The total estimated quantity of gas made during the year has been: Coal gas made at Brierfield Works (estimated) 524,406,000 cu.ft., carburetted water gas 7,106,000 cu.ft., making an estimated total of 531,512,000 cu.ft. The gross income from residuals and by-products has been £12,670, as compared with £13,656 obtained the previous year, and after deducting all the expenses of manufacture and handling of same, the net income from this source amounts to £10,711, as compared with £11,504 last year, which gives a return of 9s. 6¾d. per ton of coal carbonized, as compared with 9s. 9½d. last year, making the net cost of coal 12s. 7¾d. per ton delivered at the Works, as compared with 12s. 3d. last year. A profit of £190 was made on the concentrated ammonia plant, an increase of £98 over the previous year's figure. Street lamps show an increase in consumption of 1,245,590 cu.ft., as compared with last year. The unaccounted-for gas has decreased by 7,626,100 cu.ft., and now stands at 3·01% of the total quantity of gas made, as compared with 4·27% last year. There is now a total of 17,240 consumers; 5,057 of these have ordinary meters, and 12,183 are provided with prepayment meters. The average consumption per ordinary consumer was 33,606 cu.ft.; while the average consumption per prepayment consumer was 22,088. The sales of gas appliances at the Showroom show an increase of 62% over the preceding year. 722 cookers, boilers, fires, radiators, and water heaters, &c., to the value of £1,436 have been sold, and appliances to the number of 1,297, representing a cash value of £7,461 have been sent out on the hire-purchase system. These figures form a record for the Department. The past year has been devoted to the re-setting of eight retorts and the carrying out of minor repairs to other three settings. The demolition of the manufacturing plant at the Gas-Works, Leeds Road, Nelson, commenced in June, 1934. The total expenditure on revenue account is estimated at £77,414, and the total income at £108,177. After deduction of income-tax, interest, and sinking fund charges, a net profit of £8,791 is expected, to meet the various items in the appropriation account.

Ramsgate.

The statement on the accounts for the year ended March 31, 1935, for the Ramsgate Gas Department states that the expenditure on capital account amounted to £3,604. Of this, £1,267 represents expenditure on new plant and machinery; £1,024 on new mains and services; £858 on new fires, boilers; and £455 on new meters. The total amount provided in this year's accounts for the redemption of capital is £9,180. The revenue from gas sold amounted to £58,620, while rental of meters, cookers, profit on service laying, &c., amounted to £10,864. The total amount received from residuals amounted to £14,975. The total revenue amounts to £87,388 and the total expenditure to £64,848, leaving a gross profit of £22,539. The net profit was £5.512. In continuation of the Department's policy, £7,364 has been transferred to capital account and there is a balance carried forward amounting to £1,260. The amount of £7,364 transferred not only covers the whole of the capital expenditure for the year but provides the necessary balance for the new coke hoppers, &c., whenever it may be thought desirable to proceed with same. The total expenditure on revenue account, namely, £64,848, is £1,539 less than in the previous year. There is an increase in the cost of repairing and renewing meters of £720, and also an increase in the cost of repairing and renewing cookers, &c., of £356, but both these items should prove of ultimate benefit to the Department. Receipts from residual products amount to £14,975 as against £14,870 last year.

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Gas Markets and Manufactures

Stock Market Report

(For Stock and Share List, see later page)

Friday saw the close of one of the unpopular 21-day Accounts, and though this coincided with the holiday season and should in the nature of things have led to some easing off in the volume of business the position was quite the reverse, for it was one of the most active accounts of the year. Gilt-edged and other high-class investment stocks were the chief centre of attraction, and prices responded in consequence; 2½% Consols, 3½% Conversion Loan, and India 3% and 3½% showing the best advances on the week. The Industrial market was almost as busy, and though some profit-taking was in evidence during the middle of the week any reaction in prices was speedily recovered, investors eagerly taking advantage of any temporary relapse.

The Gas Market, on the other hand, was comparatively quiet during the four days of business, which is not unusual at this time of the year when most of the ordinary stocks are full of the interim dividend and only forced sales are coming into the market. A fair number of transactions was recorded in Gas Light units, Imperial Continental, and South-Eastern Gas Corporation shares, but elsewhere business was patchy. All price movements, however, were in an upward direction and included a further rise in South Metropolitan ordinary to 129, and, on the local Exchange, a gain of 3d. to 26s. 3d. in Newcastle units, while it will be seen in the Stock and Share List that a few preference stocks also rose in value.

A list appeared in last week's Report showing the variations in the prices of a number of ordinary stocks compared with a year ago. This week permanent debenture stocks are dealt with, and it will be seen in the following table that in all cases these have improved in value over the same period.

Debenture Stocks.

—	Quotations.		Increase Over a Year Ago.
	1934. Aug. 10.	1935. Aug. 9.	
Bournemouth 5%	122—127	123—128	1
Bristol 5%	121—123	127—130	6½
Commercial 3%	82—87	85—90	3
,, 5%	120—125	123—128	3
Croydon 5%	119—124	123—128	4
East Surrey 5%	120—125	123—128	3
Gas Light 3%	85—88	89—92	4
Liverpool 4%	100½—102½	103—106	3
M.S. Utility 4%	100—105	103—108	3
Newcastle 3½%	90½—91½	99—101	9
South Metropolitan 3%	84—87	87—90	3
South Suburban 5%	121—126	123—128	2
,, ,, 4%	102—107	105—110	3
Southampton 4%	99—104	100—105	1
Tottenham 4%	98—103	101—106	3
Wandsworth 5%	121—126	125—130	4

Current Sales of Gas Products

The London Market for Tar Products.

LONDON, *Aug.* 12.

Prices of tar products continue without change as follows:
Pitch is 33s. to 34s. per ton f.o.b.
Creosote, about 6d. per gallon.
Refined tar, 4d. per gallon in bulk at makers' works.
Pure toluole, 2s. 2d. to 2s. 3d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, 1s. 5d.; and 90/160 pyridine, about 4s. 6d. to 4s. 9d.—all per gallon naked at makers' works

Tar Products in the Provinces.

Aug. 12.

The average prices of gas-works products during the week were: Gas-works tar, 18s. to 23s. Pitch—East Coast, 31s. to 33s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 31s. to 33s.* Toluole, naked, North, 1s. 8d. to 1s. 9d. Coal-tar crude naphtha, in bulk, North, 6¾d. to 7d. Solvent naphtha, naked, North, 1s. 5d. to 1s. 5½d. Heavy naphtha, North, 9½d. to 10½d. Creosote, *ex* works, in bulk, North, liquid and salty, 5½d. to 5¾d.; low gravity, 5d. to 5½d.: Scotland, 5d. to 5⅝d. Heavy oils, in bulk, North, 5d. to 5½d. Carbolic acid, 60's, 1s. 11d. to 2s. Naphthalene, £10 to £11. Salts, 60s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Aug.* 10.

Deliveries are proceeding quite rapidly, but new business is slow and consequently prices are, to a certain extent, rather unstable.

Crude gas-works tar.—The actual value is 28s to 30s. per ton *ex* works in bulk.

Pitch remains without interest and to-day's value is not more than 32s. 6d. per ton f.o.b. Glasgow for export. For home trade 32s. 6d. per ton *ex* works in bulk is still being quoted.

Refined tar is slightly easier at 2¾d. to 3d. per gallon *ex* works in buyers' packages.

Creosote oil continues in good call with prices firm. B.E.S.A. Specification, 5¼d. to 5⅜d. per gallon; low gravity, 5¼d. to 5½d. per gallon; and neutral oil, 5¼d. to 5⅜d. per gallon; all f.o.r. in bulk.

Cresylic acid is only in small request, and, in some cases, production has been discontinued. Quotations are as under: Pale, 97/99%, 1s. 1½d. to 1s. 2½d. per gallon; dark, 97/99%, 1s. to 1s. 0½d. per gallon; and pale, 99/100%, 1s. 2½d. to 1s. 3½d. per gallon; all *ex* works naked.

Crude naphtha is commanding 4½d. to 5d. per gallon f.o.r., according to quality and district.

Solvent naphtha.—90/160 grade is 1s. 3½d. to 1s. 4d. per gallon, and 90/190 heavy naphtha is 10½d. to 11½d. per gallon.

Motor benzole is now well looked after at 1s. 3½d. to 1s. 4d. per gallon in bulk at makers' works.

Pyridines.—90/160 grade is 5s. 6d. to 6s. per gallon, and 90/140 grade 6s. to 6s. 6d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 9½	to	0 10	per gallon at works
Motor ,,	1 3	,,	1 3½	,, ,, ,,
90% ,,	1 4	,,	1 4½	,, ,, ,,
Pure ,,	1 7½	,,	1 8	,, ,, ,,

Contracts Advertised To-Day

Benzole Recovery Plant.
City of Salford. [p. 378.]

Boilers (Waste-Heat).
City of Salford. [p. 378.]

Booster.
East Dereham Gas Department. [p. 378.]

Burners.
Port Talbot Gas Department. [p. 376.]

Coal.
Market Harborough Gas Department. [p. 376.]

Coke Handling Plant.
City of Salford. [p. 378.]

Demolition.
City of Salford. [p. 378.]

Exhauster, &c.
East Dereham Gas Department. [p. 378.]

Lamp Columns.
Port Talbot Gas Department. [p. 376.]

Lamps, Reflectors, &c.
Port Talbot Gas Department. [p. 376.]

Retorts.
City of Salford. [p. 378.]

Overseas Opportunities

Johannesburg.

H.M. Trade Commissioner at Johannesburg reports that the Union Tender and Supplies Board is calling for tenders, to be presented in Pretoria by Aug. 30, 1935, for the supply of 3,334 cast-iron spigot and socket pipes 3¼ in. by 9 ft. and 100 bonding clips. (Ref. T.Y. 5,140.)

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STOCK AND SHARE LIST

Official Quotations on the London and Provincial Stock Exchanges

Issue. £	Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations, Aug. 9.	Rise or Fall on Week.	Transactions, Lowest and Highest Prices During the Week.
1,551,868	Stk.	Mar. 11	7	7	Alliance & Dublin Ord. ...	132—142	+2	139½
374,000	,,	June 24	4	4	Do. 4 p.c. Deb. ...	90—100	...	...
557,655	,,	Feb. 18	7	7	Barnet Ord. 7 p.c.	165—170	...	...
300,000	1	Apl. 8	1/4⅛	1/9⅜	Bombay, Ltd.	1 7/16—1 11/16	...	32/2½
178,480	Stk.	Feb. 18	9½	9½	Bournemouth sliding scale ...	225—235	...	...
550,050	,,	,,	7	7	Do. 7 p.c. max. ...	168—173	...	...
489,160	,,	,,	6	6	Do. 6 p.c. Pref. ...	149—154	...	152
50,000	,,	June 24	3	3	Do. 3 p.c. Deb. ...	85—90	...	88½—90½
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	106—111	...	109½
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
357,900	,,	Feb. 18	7½	7½	Brighton, &c., 6 p.c. Con. ...	173—178	...	...
649,955	,,	,,	6½	6½	Do. 5 p.c. Con. ...	153—158	...	...
205,500	,,	,,	6	6	Do. 6 p.c. B. Pref.	145—150	...	...
1,487,500	,,	July 8	5	5	Bristol, 5 p.c. max.	120—123a	...	...
120,420	,,	June 7	4	4	Do. 1st 4 p.c. Deb. ...	102—104a	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	101—103a	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	127—130a	...	...
855,000	,,	Mar. 11	7	8	British Ord.	154—159	...	156½
100,000	,,	June 7	7	7	Do. 7 p.c. Pref.	160—165	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. "B" Cum. Pref.	112—117	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	95—100	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	109—114	...	...
200,000	,,	,,	...	17/6	Do. 3½ p.c. Red. Deb. ...	99—101	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov.'33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	June 24	4½	4½	Do. 4½ p.c. Deb. ...	83—88	...	85½—86
626,860	,,	July 22	6	6	Cardiff Con. Ord.	127—132*	...	...
237,860	,,	June 7	5	5	Do. 5 p.c. Red. Deb.	107—112	...	...
157,150	,,	Feb. 4	5	6½	Chester 5 p.c. Ord.	111—116b	...	...
98,936	1	Mar. 25	2/-	2/-	Colombo, Ltd., Ord.	1⅞—1⅞	...	...
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	20/6—22/6	...	...
609,204	1	Mar. 25	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	20/6—22/6	...	...
296,053	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref.	26/—28/-	...	...
1,775,005	Stk	Feb. 4	5	6	Commercial Ord.	103—108	...	103—105½
620,000	,,	June 7	3	3	Do. 3 p.c. Deb. ...	85—90	...	89
286,344	,,	Feb. 18	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
807,560	,,	Feb. 18	7	7	Croydon sliding scale... ...	155—160	...	...
569,590	,,	,,	5	5	Do. max. div.	115—120	...	...
620,385	,,	June 24	5	5	Do. 5 p.c. Deb.	123—128	...	...
542,270	,,	Feb. 18	7	10	Derby Con.	185—195c	...	...
55,000	,,	June 24	4	4	Do. 4 p.c. Deb.	100—105c	...	...
239,000	,,	Feb. 4	5	5	East Hull Ord. 5 p.c. ...	108—113	...	...
181,625	,,	Feb. 4	6	6	East Surrey Ord 5 p.c. ...	131—136	...	...
175,609	,,	June 7	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
1,002,180	,,	Mar. 11	†	17	European, Ltd.	170—180	...	...
19,313,481	,,	Feb. 4	5½	5½	Gas Light & Coke 4 p.c. Ord.	28/—28/6f	...	28—28/6
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	89—92	...	90½—91
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	109—112	+1	112
8,602,497	,,	June 7	3	3	Do. 3 p.c. Con. Deb. ...	89—92	...	90—92
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	115—118	...	...
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	112—115	...	113½—115
270,466	,,	Feb. 18	6	6	Harrogate New Cons. ...	135—140	...	...
140,000	1	Mar. 25	1/7½	1/7½	Hongkong & China, Ltd. ...	1¼—1¼	...	...
213,200	Stk.	Feb. 18	6	6	Hornsey Con. 3½ p.c.... ...	128—138	...	136—136½
5,600,000	,,	May 13	10	14	Imperial Continental Cap. ...	215—220	...	215—216½
223,130	,,	July 22	3½	3½	Do. 3½ p.c. Red. Debs.	90—95*	...	...
285,242	,,	Feb. 18	8½	8½	Lea Bridge 5 p.c. Ord. ...	175—185	...	...
2,167,410	,,	Feb. 18	6	6	Liverpool 5 p.c. Ord.... ...	139½—141½b	...	...
245,500	,,	June 7	5	5	Do. 5 p.c. Red. Pref. ...	105—110b	...	...
306,083	,,	July 8	4	4	Do. 4 p.c. Deb.	103—106b	...	...
165,736	,,	Feb. 18	8	10	Maidstone 5 p.c. Cap. ...	185—195	...	...
63,480	,,	June 24	3	3	Do. 3 p.c. Deb. ...	82—87	...	...
75,000	,,	May 27	†10	†10	Malta & Mediterranean ...	212—222	...	...
392,000	—	Apl. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	100—105	...	...
231,978	Stk.	Feb. 4	5	5	M. S. Utility "C" Cons. ...	110—115	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	102—107	...	...
360,075	,,	June 24	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
148,955	,,	,,	5	†5	Do. 5 p.c. Deb. ...	123—128	...	...
125,000	—	July 1	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	97—100	...	...
675,000	,,	June 24	†3	†3	Montevideo, Ltd.	48—58	...	...
2,061,315	,,	Feb. 18	5	5⅝	Newcastle & Gateshead Con.	25 9—26 9df	+3	...
682,856	,,	,,	4	4	Do. 4 p.c. Pref. ...	108—109d	+2	...
776,706	,,	June 7	3½	3½	Do. 3⅛ p.c. Deb. ...	99—101d	...	...
277,285	,,	Oct. 8	5	5	Do. 5 p.c. Deb. '43 ...	105—107d	...	...
274,000	,,	Feb. 4	5	5	Newport (Mon.) 5 p.c. max....	115—120a	...	...
225,000	,,	Feb. 18	7½	7½	North Middlesex 6 p.c. Con.	165—175	...	...
396,160	,,	Feb. 4	5	5	Northampton 5 p.c. max. ...	107—112	...	...
300,000	,,	Apl. 29	†9	†7	Oriental, Ltd.	168—173	...	...
416,617	,,	June 7	8	8	Plym'th & Stonehouse 5 p.c.	162—167	...	...
504,416	,,	Feb. 4	8	8½	Portsm'th Con. Stk. 4 p.c. Std.	173—178	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	110—115	...	...
114,000	,,	July 22	5	5	Preston 5 p.c. Pref.	106—111*	...	...
321,961	1	Apl. 8	...	...	Severn Val. Gas Cor. Ld. Ord.	22/—23/-	...	22 9—22 10½
319,510	1	Mar. 25	...	...	,, 4½ p.c. Cum. Pref.	22/—23/-	...	...
1,736,968	Stk.	Feb. 18	6	6	Sheffield Cons.	141—143e	...	...
95,000	,,	June 24	4	4	Do. 4 p.c. Deb.	102—104e	...	...
133,201	,,	Feb. 18	8½	8½	Shrewsbury 5 p.c. Ord. ...	142—147	...	...
90,000	10	May 27	‡3	‡3½	South African	3—4	...	...
1,061,779	1	May 13	1/2½	1/2½	South East'n Gas Cn. Ld. Ord.	28/—29/-	...	28/6—29/-
845,016	1	Mar. 11	-/10½	-/10½	Do. 4½ p.c. Red. Cum. Pref.	22/6—23/6	...	23/—23/4½
450,000	Stk.	Feb. 4	7 4/4	4	Do. 4 p.c. Red. Deb. ...	100—103	...	...
6,709,895	,,	Feb. 4	5	6½	South Met. Ord.	127—131	+1	129—131
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf. ...	147—152	...	...
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf. ...	109—112	+2	...
1,895,445	,,	June 24	3	3	Do. 3 p.c. Deb.	87—90	...	89—90
1,000,000	,,	July 8	5	5	Do. 5 p.c. Red. Deb....	112—117	...	...
209,820	,,	Feb. 18	8½	8½	South Shields Con.	174—176d	...	...
1,543,795	,,	Feb. 18	6	6	South Suburban Ord 5 p.c. ...	130—135	...	...
512,825	,,	,,	5	5	Do. 5 p.c. Pref. ...	121—126	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref. ...	105—110	...	...
888,587	,,	June 7	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
250,000	,,	,,	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
647,740	,,	Feb. 4	5	5	Southampt'n Ord. 5 p.c. max.	116—121	...	...
121,275	,,	June 7	4	4	Do. 4 p.c. Deb.	100—105	...	...
350,000	,,	Feb. 4	5½	5½	Swansea 5½ p.c. Red. Pref. ...	115—120	...	...
200,000	,,	June 7	6½	6½	Do. 6½ p.c. Red. Deb. ...	98—103	...	...
1,076,490	,,	Feb. 18	6½	6½	Tottenham and District Ord.	148—153	...	151—152½
409,835	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	131—136	...	135½—136
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	123
334,615	,,	June 7	4	4	Do. 4 p.c. Deb. ...	101—106	...	...
369,774	,,	Feb. 4	7	7	Uxbridge, &c., 5 p.c.	150—155	...	153
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	118—123	...	...
1,326,700	,,	Feb. 4	7	7	Wandsworth Consolidated ...	157—162	...	...
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	121—126	...	...
1,317,964	,,	June 7	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
338,300	,,	,,	26/8	4	Do. 4 p.c. Deb. ...	102—107	...	...
158,400	,,	Feb. 18	5	6g	Winchester W.& G. 5 p.c. Con.	116—121	...	...

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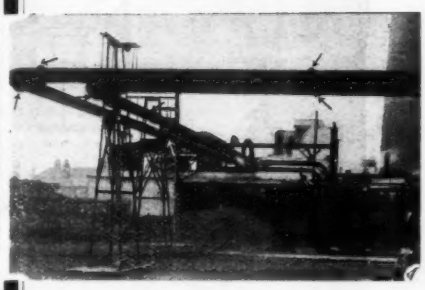

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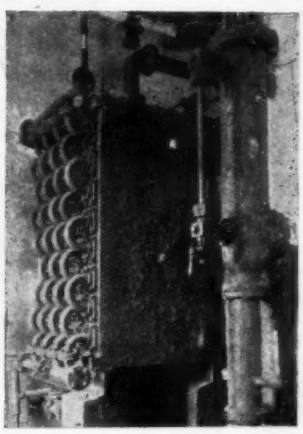

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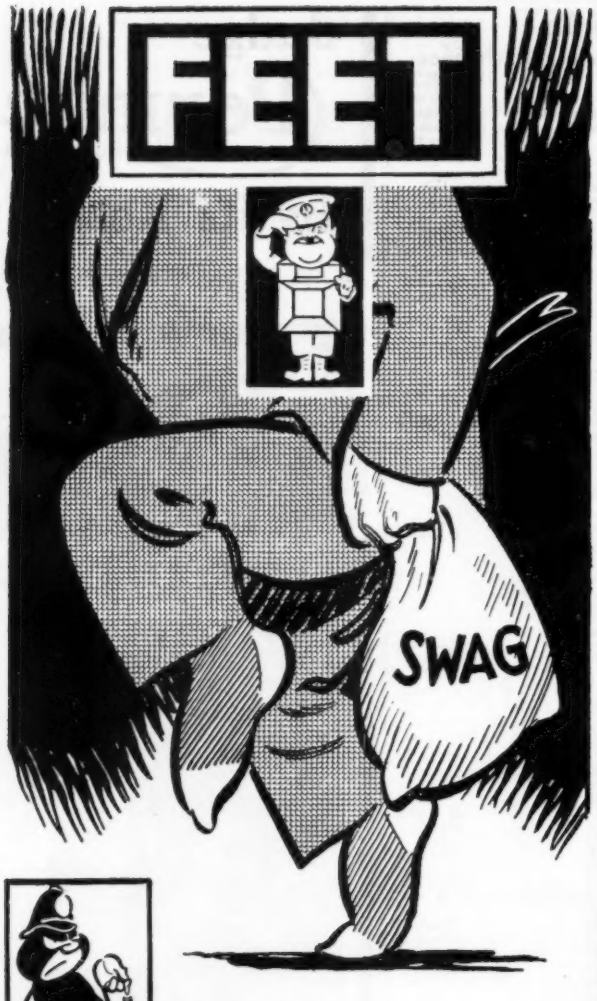

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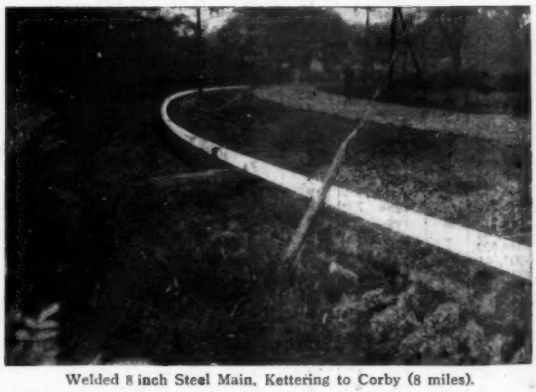

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